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MONTEREY, CALIFORNIA

THESIS

SPACE SUPPORT FOR THE WARFIGHTER: DETERMINING THE BEST WAY TO PROVIDE SPACE CAPABILITIES AT THE ARMY DIVISION AND BRIGADE LEVELS

by

Eric N. Strom

June 2009

Thesis Advisor: Charles Racoosin
Second Reader: Alan Scott

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SPACE SUPPORT FOR THE WARFIGHTER: DETERMINING THE BEST WAY TO PROVIDE SUPPORT AT THE ARMY DIVISION AND BRIGADE LEVEL

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Submitted in partial fulfillment of the
requirements for the degree of

**MASTER OF SCIENCE IN
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LIST OF ACRONYMS AND ABBREVIATIONS

3Y	Three Yankee Identifier
ABCS	Army Battle Command System
ACCM	Alternate Compensatory Control Measures
ADA	Air Defense Artillery
AFATADS	Advanced Field Artillery Targeting & Direction System
ARSST	Army Space Support Team
ASAS	All Source Analysis System
ATEx02	Army Transformation Experiment 2002
BCT	Brigade Combat Team
BFT	Blue Force Tracker
BRITE	Broadcast Request Imagery Technology Experiment
C2PC	Command Control Personal Computer
CET	Commercial Exploitation Team
COP	Common Operating Picture
COPS	Contingency Operations-Space
COTS	Commercial Off the Shelf
CPN	Command Post Node
CSB	Commercial SATCOM Branch
DCGS	Distributed Common Ground System
DISA	Defense Information Systems Agency
DOTMLPF	Doctrine, Organization, Training, Material, Leadership, Personnel, Facilities
DSCS	Defense Satellite Communication System

DTES	Division Tactical Exploitation System
DTSS	Digital Topographic Support System
FA40	Functional Area 40
FBCB2	Force XXI Battle Command Brigade and Below
FCS	Future Combat System
FM 3-14	Field Manual 3-14
GBS	Global Broadcast Service
GEN	General
GMF	Ground Mobile Forces
GPS	Global Positioning System
HF	High Frequency
HMMWV	High Mobility Multi Wheel Vehicle
HVMP	High Volume Map Production
IMETS	Integrated Meteorological System
INMARSAT	International Maritime Satellite
IPSAT	Internet Protocol Satellite
ISAT	Intelligence Situational Awareness Tool
ITSB	Integrated Theater Signal Battalion
JCF AWE	Joint Contingency Force Advanced Warfighting Experiment
JNN	Joint Network Node
JP 3-14	Joint Publication 3-14
JRTC	Joint Readiness Training Center
JSTARS	Joint Surveillance and Target Attack Rader System
MC02	MILLENNIUM CHALLENGE

MCS	Movement Control System
MEO	Medium Earth Orbit
MI	Military Intelligence
MILSATCOM	Military Satellite Communication
MMC	Mission Management Center
MSE	Mobile Subscriber Equipment
MTI	Moving Target Indicators
MTOE	Modified Table of Organization and Equipment
NGA	National Geospatial-Intelligence Agency
NRO	National Reconnaissance Office
NTC	National Training Center
OEF	OPERATION ENDURING FREEDOM
OIF	OPERATION IRAQI FREEDOM
PNVT	Precision Navigation, Velocity and Timing
SATURN	Space Applications Tech Research Network
SBMCS	Space Battle Management Core System
SCOPES	Space Common Operating Picture Exploitation System
SDST	Space Decision Support Template
SLEP	Service Life Enhancement Program
SMAT	Space/Missile Analysis Tool
SMDC	Space and Missile Defense Command
SOOQC	Space Operations Officer Qualification Course
SORC	Spectral Operations Resource Center
SOS	Space Operations System

SOS-I	Space Operations System-Imagery
SPEC-TR	Spectral Exploitation Cell-Transportable
SSE	Space Support Element
SSET	Space Support Element Toolset
STK	Satellite Tool Kit
STO	Special Technical Operations
TACSAT	Tactical Satellite
TES-LITE	Tactical Exploitation System-Lightweight Intelligence Tactical Equipment
TOC	Tactical Operations Center
TSII	Trojan Spirit II
TSOC	Tactical Space Operations Course
UAV	Unmanned Aerial Vehicles
UHF	Ultra High Frequency
USSTRATCOM	U.S. Strategic Command
WGS	Wideband Global System

EXECUTIVE SUMMARY

One of the primary benefits of space capabilities when delivered to tactical commanders is that they greatly enhance battlefield situational awareness. Many equipment platforms have been developed to provide these products to the lowest possible levels. To provide personnel expertise, the Space Support Element (SSE) emplaced space-educated operations officers down as low as the Brigade Combat Team. Although utilization of space operations officers at Division and Brigade levels ensured a point of presence for the space community in combat units, and initially, these officers provided valuable knowledge that influenced operations, as missions change the utility of having full-time space staff reaches a point of diminishing returns. This thesis examines the effectiveness of that approach and recommends methods that provide the same level of service more efficiently.

Current standardized space support for the Division and Brigade exists in the form of the Space Support Element (SSE). When first envisioned the SSE was designed to provide organic space capabilities to the lowest practical tactical level, but as requirements have evolved, the need for full time space staff at those levels has diminished. Space capabilities are now found in several different areas of the Division staff and the amount of time spent by space operations officers on space has dwindled to very low levels. Highly advanced systems have been developed to provide intelligence, communication, and early warning through specially trained individuals scattered among the various staff elements. The use of these systems requires only limited space officer interaction. Personnel with minimal training can provide the limited amount of space knowledge needed on a permanent basis. Rather than maintain organic space staff that are only moderately employed, a more effective use of those personnel is to assign them to Army Space Support Teams (ARSSTs). The ARSST concept of dedicated space teams deploying in support of Army operations is a more efficient utilization of the Army Space Cadre. The main

advantage of the ARSST concept is the continual exposure to space and insider access to the 1st Space Brigade's resources.

This thesis proposes three key recommendations to improve the overall utilization of Army space personnel. The first recommendation is to educate leadership on ways space can affect operations. This is accomplished through senior leader education, but also with an officer-training program that emphasizes promoting space within tactical units. A key component of the training outreach involves emplacing FA40 trainers within National Training Centers to train deploying units in the applications of space to their mission. The second is to broaden the Army Space Cadre to utilize space skilled staff officers outside the space operations officer career field and develop an enlisted space operations specialty. This recommendation includes subordinate portions including the expansion of the FA40 community into an enlisted specialty and an FA40 acquisition specialty. The final recommendation is to reallocate SSE members to enhance the ARSST model of space support. This shift in personnel would ensure the space-related proficiency of the total career field is greatly improved and a larger stable of ready teams are available to support Division and Brigade activities.

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I. ORIGINS OF TACTICAL SPACE

DESERT STORM was a significant landmark for application of military space-based capabilities. Prior to DESERT STORM space was considered primarily a strategic tool with only limited usability for troops in a tactical environment. Since the dawn of the Information Age, space served the government as either a means of providing strategic national security or global communications capability. DESERT STORM demonstrated for the first time that there were many ways to utilize space beneficial to tactical commanders on the ground. The Assistant Secretary of the Air Force noted in 1991, that it "was the first large scale opportunity for our forces in the field to understand that space systems are vital to their success." [1] The gains for forces on the battlefield were numerous. Space capabilities provided global communications, intelligence resources, and the ability to see enemy dispositions on a very large scale. Although those resources remained largely unavailable to the lower echelon forces, such as companies and platoons, they were used for planning purposes as low as the battalion level.[2] In some respects, the amount of availability would be considered inadequate by current standards. For the timeframe considered, however, they were groundbreaking and cutting edge.

The years leading from 1991 to the initial invasion of Afghanistan and the Global War on Terror included many technological advancements as well as shifts in doctrine for the use of space assets throughout the military. Information technology dependence, including both satellite communications and space intelligence applications established during DESERT STORM increased in seeming parallel with Moore's Law. Although tactical military systems lagged behind commercially available ones, space access became more available than

[1] *JP 3-14, Joint Doctrine for Space Operations*, Chairman of the Joint Chiefs of Staff, 9 August 2002, II-4.

[2] Rodger S. Pitt, 2008. Realities of the Space Age & the Realities of Carl von Clausewitz's Theories of "Fog and Friction." *Army Space Journal* 7(2): 55.

ever before. The introduction of space into military planning, operations, and doctrine in the post-DESERT STORM culture was a significant milestone in tactical space.

The Army determined that it needed space-trained professionals in the mid-1990s due mainly to its increasing requirement to use space to accomplish varying missions. Key among the users of space within the Army was the Space and Missile Defense Command (SMDC). The primary mission of SMDC is to ensure the nation's missile defense capability. Additionally, SMDC serves as the Army proponent for space and high altitude operations. They are the main point of focus within the Army on space.[3] Therein lies the source of some of the difficulties in the proper application of space in the Army. The Army's primary voice for space is not dedicated to space as its primary mission. Rather, the SMDC senior leadership is comprised of many Air Defense Artillery (ADA) officers due to a history of involvement in missile defense.

Space operations, as understood in the current Army, are founded on the guidance and doctrine established by SMDC. Chief among the contributions of SMDC is the formation of the Army's professional space cadre. That cadre began as Army officers and civilians who had worked in the space field, but rapidly evolved into a new career specialty known as Functional Area 40 (FA40). First established in 1998, the FA40s initially served within strategic organizations both joint and Army centric. The events of September 11 had repercussions around the government, but especially in the Army space field. The Global War on Terror fueled a spirit of modularization and modernization within the Army that redesigned the way the entire Army was structured. GEN Schoomaker, the Army Chief of Staff at the time, conceived of a modular Army with widely varying assets and capabilities available in brigade-sized elements known as Brigade Combat Teams (BCTs). These BCTs would include all of the assets they would

[3] Space and Missile Defense Command, 2009. What is SMDC/ARSTRAT? Army Organizational Website. http://www.army.mil/institution/organization/unitsandcommands/commandstructure/smdc/ (accessed January 4, 2009).

need to wage war anywhere in the world. Previously, deploying units were "sliced" together from many different places to form a collage of capabilities to accomplish a specific mission. BCTs would have their own organic capabilities for any mission. For example, they would have their own communications, intelligence, logistics, and security assets. The impact on the space community was an initiative to put those capabilities in tactical units for the first time. In 2002, the Army explored the concept of putting FA40s and organic space capabilities outside of the strategic world in an exercise called MILLENNIUM CHALLENGE 2002 (MC02). During MC02, an organic space section was attached to the 82nd Airborne Division in Fort Bragg, North Carolina. The result of those experiments was the genesis of the Space Support Element (SSE). The SSE's mission was to support commanders at Army Corps and Division levels with FA40 space trained officers and an internal space capability that belonged to the supported unit all of the time. [4]

In the years following the initial establishment of SSEs, several forays into lower level units attempt to bring space access closer to the tactical commanders and soldiers directly using the resources. The focus of this thesis is on the space capabilities that are available for Army tactical commanders. Specifically, the thesis will explore the space capabilities available for Division and Brigade commanders and the utilization of the Army professional space cadre assigned to those units. The end state of this research is to examine the assets those levels of command currently employ and to determine the best way to employ both the space resources and the Army's space-educated FA-40 personnel. Along the way, a description of how personnel staffing and space equipment evolved will provide insight into the problems associated with the way FA40s are currently used.

This thesis is divided into two major portions: a survey of space equipment and an organizational study of operational staffing. Space equipment spans the

[4] Strategic Missile Defense Command, *US Army Space Support Element (SSE) History 1998-2006: From Concept to Combat Capability* (brief, Peterson AFB, CO, October 2006).

development, most current capabilities, and forecasts for the modular tactical space systems employed throughout the Army. The varied applications combined with the most current technology empower tactical users to explore space products unavailable as recently as five years ago. Space staffing explores the use of FA40 Space Operations Officers. Through a survey of officers currently serving as SSEs around the Army, an in-depth study of how decisions are made to develop SSE positions and the development of SSE doctrine, a greater understanding of tactical space becomes visible. Blending knowledge of capabilities, staffing, doctrine, and tactical needs, a final recommendation of the most effective use of FA40 personnel and resources for tactical commanders becomes identifiable.

II. TACTICAL SPACE CAPABILITIES

The purpose of this section is to clarify requirements from a tactical commander's standpoint and detail capabilities that currently exist. Capabilities range from Military Satellite Communications to navigation and intelligence-gathering systems and will be covered in detail. Some effort is also made to discuss future trends as they impact space operations. The result will be a solid understanding of not only what the modern tactical commander wants, but also how they get the things they need.

Any thorough examination of capabilities begins with a study of requirements. As Stanley Weiss and Michael Williams state in Space Mission Analysis and Design, "all requirements must begin with succinct, but well defined user and customer mission needs." [5] The significance for tactical space systems is no different from any other system in that the problem starts with a user's needs. A tactical commander wants to accomplish their mission and uses tools in order to do so. Space assets provide a possible tool, but perhaps not the only tool. As common sense sounding as it is, the best way to help commanders achieve mission success is to analyze what they need and then determine how best to handle the problem.

Often the tools available are not correct fits for an actual mission. The tools may be comprised of antiquated equipment left over from an older era when the unit had a different mission. A good example of this can be seen in the use of Mobile Subscriber Equipment (MSE). MSE is a communications system developed in the 1980s using primarily line of sight radio systems and providing primarily voice communications. [6] When OPERATION IRAQI FREEDOM (OIF) began in 2003 the inability of MSE equipment to deliver acceptable bandwidth

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[5] Wiley J. Larson, and James R. Wertz, eds, 1999. *Space and Mission Analysis and Design*. El Segundo, CA: Space Technology Library: 73.

[6] Rebecca R. Raines, 1996. *Getting the Message Through: A Branch History of the U.S. Army Signal Corps*. Washington D.C.: Center of Military History: 349.

created a substantial requirement vs. capability gap. The requirements in 1980 called for the ability to "talk" anywhere on the battlefield making voice the focus of most tactical communication effort. The disparity is demonstrated keenly in a 2003 Army Signal Center produced briefing that described a successful communications network being composed of 93% voice, 7% data, and 0% video.[7] This briefing reflects an inability to see that voice capabilities had already been eclipsed by data in terms of relevance, but were still being featured as the main driver behind tactical networks. Voice was no longer the high demand commodity it had been in 1980. Data communications had become far more important and the use of data products far more common so any study focusing on a heavily voice skewed network was antiquated. Yet, requirements developed from 1980-era communication gaps still existed as recently as the 2003 briefing. For OIF, commanders needed large bandwidth products in the form of images, presentations, and video. They could use them from facilities connected to the main network, but could not use them in tactical environments using MSE. The available equipment was simply not capable of fulfilling the mission requirements. Major changes were required for the Army to develop the tactical communications capabilities to match the requirements of the tactical commanders.[8] It is, therefore, vital to ensure the equipment or systems used to solve a problem actually solve the current problem and not a previous one.

There is a symbiotic relationship between capabilities and requirements. Clearly, having solid mission based requirements is key to a successful capability. This is true whether developing a networking system or a space operations platform. The varied means by which commanders use space systems to accomplish their mission is also important. Having a large stable of space options available, but either not using them or using them ineffectively can adversely affect mission accomplishment on a local level and impact the success

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[7] Kevin J. Cogan and Ray DeLucio, 2004. *Network Centric Warfare Case Study: U.S. V Corps and Third Infantry Division during Operation Iraqi Freedom Combat Operations (March - April 2003. Carlisle Barracks, PA: U.S. Army War College: 22.*

[8].Ibid., 7.

of entire programs on a national level. The proper application of a capability for its intended mission ensures that the commander's intent is achieved and ultimately the unit's goals and the nation's goals as well.

A. TACTICAL COMMANDER REQUIREMENTS

Commanders at the Division or Brigade level have many uses for space on the modern battlefield. A warfighting commander needs to answer the same questions today that commanders have asked since the time of the Spartans. Namely, where am I, where are my troops, where is the enemy, what is the enemy doing, how do I communicate orders to my troops, and what environmental effects are possible to influence the outcome of the battle? In those Hellenistic years, many of these questions were easily answered by a physical glance around the battlefield from a high vantage point. This is probably best exemplified by Alexander the Great in the battle of Gaugamela. Alexander positioned himself on a hilltop, assessed Darius III's Persian force movements, directed the movement of his own forces, and finally led a charge to what he determined to be the decisive spot.[9] Some would argue that Napoleon's contribution to the conduct of war was to add a new level of strategic intelligence and situational awareness. Systematic intelligence gathering was completed through his Statistical Bureau for strategic information and an efficient internal Imperial Headquarters staff for tactical events. Van Crevald states that "almost as many means were employed then as today: newspapers were systematically collected and translated, spies and agents were planted in every important city and used the imperial mail for forwarding coded messages."[10] For many historians, the Napoleonic era of warfare was the origin of the modern intelligence network. Tactical needs for commanders change very little over time. It can be said that only methods, quality, and quantity change.

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[9] Martin Van Crevald, 1985. *Command in War*. Cambridge, MA. Harvard University Press: 44.

[10] Ibid., 66.

The modern commander has many of the same requirements as Napoleon, but uses much more technologically advanced methods. Today's tactical commander needs to know a wide range of facts with near real time speed. For example, they need to know where their own, other friendly forces, and enemy forces are located with great precision. This can give a tactical overview of the current situation and prevents possible fratricide. In a divergence from eighteenth century commanders, the modern commander must keep a vigilant eye on weapons of mass destruction that can come in the form of ballistic missiles. The prediction of weather can also be helpful for commanders to determine strategy or other system effects. Weather's effects can be measured in its impact to planned operations, the ability to collect intelligence, and effects on communications systems. Through the use of intelligence satellites or other intelligence means, the locations and intent of enemy forces can be determined. High bandwidth capacity communications satellites can provide a commander the ability to both speak down to the lowest level of their command or as far up the chain of command as the White House. Each of these factors play into the situational awareness of the commander and the role that space and the FA-40 plays and will be covered in detail.

B. MILSATCOM

The use of satellites to communicate over long distances can be traced to the early 1960s. As explained earlier, they did not truly become a major force multiplier in tactical operations until DESERT STORM. [11] Today, Division and Brigade commanders use MILSATCOM in several different ways. Satellite communications can come in the form of high capacity access to data and voice; small portable devices permitting limited data and voice, and small commercial services using telephones that are highly portable.

[11] JP 3-14, *Joint Doctrine for Space Operations*. Chairman of the Joint Chiefs of Staff, 9 August 2002, II-4.

1. Defense Satellite Communication System

High capacity services imply a level of access to global networks that enables commanders to use any products they can obtain from non-tactical environments. The main system in operation for long-haul high bandwidth communications is the Defense Satellite Communication System (DSCS). The DSCS program has been evolving since the 1960s and is currently up to DSCS III Service Life Enhancement Program (DSCS III SLEP). The last DSCS III satellite was launched in August 2003. DSCS operates in the Super High Frequency band specifically within the frequency ranges of 7.25 to 7.75 GHz for downlink and 7.9 to 8.4 GHz for uplink transmissions. The total data throughput of a single DSCS III SLEP yields 250 Mbps.

Tactical units are able to access the DSCS system through the use of Ground Mobile Forces (GMF) terminals. The primary GMF terminals supporting DSCS are the AN/TSC-93D, shown in Figure 1, and the AN/TSC-85D, shown in Figure 2. The "D" model enables the unit to take advantage of SLEP upgrades to the DSCS architecture.

Figure 1. AN-TSC-93D[12]
[From The Army Satellite Communications Architecture Book]

[12] U.S. Army 25E Training Course Handbook, 2008. *The Army Satellite Communications Architecture Book.* January 2008. U.S. Army Signal Center, Fort Gordon, GA: 6-164.

The TSC-93D and TSC-85D are both capable of establishing links with a throughput of 2048 kbps. The main difference between the two assemblages is the number of links available. The TSC-85D is designed to function as a "hub" at a Corps or higher headquarters with a capability of establishing five links and a total throughput of 10 Mbps.[13] The TSC-93D is generally at a Division headquarters and is capable of establishing either one 2048 kbps link or two 1152 kbps links.

Figure 2. AN/TSC-85 [14]
[From The Army Satellite Communications Architecture Book]

Ground Mobile Forces terminals are generally maintained by Integrated Signal Battalions (ITSBs) and deployed in support of Joint Task Forces, Corps, or Division headquarters. These ITSBs are Signal units that are specially equipped with a wide variety of communications equipment. When required to support Army operations with DSCS access they are attached to the supported headquarters for the mission's duration. Depending on the operation, they may

[13] 25E Training Handbook, 6-16.

[14] Ibid., 6-14.

even be assigned as low as the Brigade Combat Team. When these teams are deployed with TSC-85D or TSC-93D terminals, they typically deploy with a Signal Officer or Signal Non-Commissioned Officer who is responsible for the operation of the equipment. The G/S-6 section of the unit will support the logistic needs of the GMF team and serve as their liaison with the unit.[15]

2. Wideband Global System

As the DSCS configuration nears the end of its service life, new systems are being developed to cover the requirement for global military satellite communications. The Wideband Global System (WGS) enables significant improvement over the DSCS program. WGS provides 2.1 to 3.5 Gbps of data throughput as compared to DSCS maximum throughput of 250 Mbps. The incredible improvement is achieved with X- and Ka-band frequencies, frequency reuse and significantly increased power.

Using Ka-band frequencies allows WGS to communicate with a much wider range of commercial terminals made by a wide variety of manufacturers. Ka-band terminals like the one shown in Figure 3 are generally assigned to units equipped with Joint Network Node (JNN) equipment. Brigade Combat Teams and Division Headquarters are typically fielded JNN assemblages. JNN was designed to connect users from the company level all the way to the Army level through existing government IP networks. Each BCT would be fielded its very own JNN and each battalion within it would have its own Command Post Node CPN. Some larger BCTs would have two JNNs. Division level headquarters would have something called a Hub Node, an 18-wheeler based giant version of the JNN. [16]

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[15] U.S. Signal Center, 2005. *The Integrated Theater Signal Battalion: Way Ahead*. (Briefing given March 2005 at Fort Gordon, GA.)

[16] Army Field Manual 6-02.60, 2006, *Tactics, Techniques, and Procedures for the Joint Network Node – Network*. Washington D.C.: 4-3.

Figure 3. JNN Ka-Band Terminal[17]
[From DataPath Integrated Solutions website]

Standard X-band GMF terminals such as the AN/TSC-93D and AN/TSC-85D also work with the WGS platform. The WGS constellation is configured with X-band capabilities that provide the same level of service available on the DSCS satellites. The first of six WGS satellites was launched on October 10, 2007, and put into service in April of 2008. [18]

3. Single Channel Tactical Satellite

There is another genre of MILSATCOM available to Division and Brigade units. Single channel Tactical Satellite (TACSAT) systems operate in the UHF frequency range and provide low throughput data and one-way voice. The purpose of these TACSAT terminals is to provide a small, easily transportable communications device that can allow a soldier to talk from remote locations. Under general conditions, there are no FA40s assigned to locations remote enough to use these devices as a primary means of communications. There

[17] DataPath Integrated Solutions, http://www.thedatapathuplink.com/issue1/ET3000.gif (accessed January 17, 2009).

[18] Ken Warren, 2007. WGA Launch ushers in new era of information dominance.*45th Space Wing Public Affairs,* October 10..http://www.patrick.af.mil/news/story.asp?id=123072439 (accessed January 17, 2009).

may, however, be access to UHF satellite radios in a Division or BCT Tactical Operations Center (TOC). In such cases, a communications radio operator would operate the equipment and might seek out assistance from an FA40 for troubleshooting. The main piece of UHF TACSAT equipment used in the Army currently is the AN/PRC-117, which is made by Harris Communications and shown in Figure 4. The AN/PRC-117 operates in several VHF frequency ranges, but for satellite communications uses the UHF range between 225 and 512 MHz. The voice capability only operates in simplex or half-duplex mode and the data throughput is limited to a maximum of 115.2 kbps, but the unit is only slightly larger than a shoebox and fits easily into a backpack. Therefore, with a very minimally sized package, voice and data capability can be obtained from virtually anywhere in the UHF Follow-On (UFO) satellite coverage area. [19]

Figure 4. AN/PRC-117/G Satellite Radio[20]
[From Harris Radio-Communications]

4. FA40 Role in SATCOM

The role of the FA40 assigned to a Division or Brigade in SATCOM operations can involve a wide variety of systems. Whether GMF, Ka-band commercial communications, or single channel TACSAT systems, FA40 contributions can be visible in several different capabilities that center on a specialized knowledge of space. Playing a key role in the planning of SATCOM, FA40s provide knowledge of space related weather impacts on communications.

[19] Harris Radio-Communications, *AN/PRC-117/G Specifications*. http://www.rfcomm.harris.com/products/tactical-radio-communications/an-prc-117f-hq.pdf. (accessed January 17, 2009).

[20] Ibid.

Predicting possible outages at key times can be critical when orchestrating operations that require wideband access. Frequency de-confliction and coverage predictions can also be very important in operations planning. Additionally, assisting Signal units in troubleshooting satellite problems can significantly contribute to the restoration of services.[21] Troubleshooting assistance can come in two main ways: coordination with satellite control centers for status information and identifying satellite interference sources. Tracking a satellite constellation's operational status can be vital in identifying what limitations exist in any SATCOM system. Understanding how to obtain and interpret those status reports can be invaluable for advising commanders before important decision points. Not only can FA40s assist in identifying sources of interference for satellite links, they are also capable of determining High Frequency (HF) radio propagation capabilities. Although HF radio use does not fall within the confines of SATCOM, its versatility in many Division and Brigade operations makes it a highly utilized resource. Division and Brigade staffs have Signal personnel assigned to operate these communications systems, but often the FA40 can provide a subset of space-centric skills that enhance capabilities and provide a local resource for assistance. [22]

C. PRECISION NAVIGATION AND TIMING

As soon as humans started traveling over long distances, they needed to know how to navigate. Sailors learned how to navigate on the water with sextants by using stars as reference points. In addition, land travelers learned to use a compass to take advantage of the Earth's own magnetism to navigate. Navigation has always been important to the military just as it has for civilian travelers. During the modern era of land warfare, the compass was the primary tool for commanders to coordinate movement. Every soldier was taught basic

[21] U.S. Space and Missile Defense Command, 2007. *FA40 Professional Reference Guide.* (Space Operations Officer Qualification Course handout. Peterson AFB, CO): 52.

[22] Association of the United States Army (AUSA), 2004. Army Space Forces – Enabling the Joint Warfighter. *Institution of Land Warfare Journa*l no. 100: 3.

land navigation skills to ensure they could use a map and compass in order to complete their mission. The year 1993 marked the beginning of the end of the era of the compass and the sextant. A road of navigation discovery that had started in 1974 with the first Global Positioning System (GPS) test satellite ended when the Air Force completed the 24-satellite constellation of the GPS on June 26, 1993. [23] Since the completion of the GPS constellation, both the military and the civil sector have grown increasingly more reliant on it.

Since the introduction of GPS into military operations, its impact has been significant enough to force the re-writing of tactics and doctrine. Initially, GPS had three main objectives: surveying the Earth in order to make more accurate maps and tools, azimuth determination to help navigate on the ground, and inertial navigation for guidance systems. [24] As the system has matured and the many potential applications have become more evident GPS has worked its way into practically every aspect of tactical operations. Weapons can be guided with such precision that they can destroy targets without harming nearby buildings. Soldiers and equipment locations can be identified within feet of their actual position on a near-real-time basis through the use of Blue Force Tracking. GPS provides situational awareness on a global scale and gives tactical commanders a view of what is going on with their units at any given moment.

Jamming is the altering or denial of a GPS signal due to either intentional or unintentional means. There are multiple methods of jamming. In its simplest form, transmitting power at a certain frequency or generating noise over a range of frequencies to prevent reception of GPS signals accomplishes GPS jamming. More elaborate methods such as spoofing work to give misleading and inaccurate readings. Indications present when GPS jamming is ongoing can

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[23] The National Academy of Sciences, *The Global Positioning System: The Role of Atomic Clocks.* http://www.beyonddiscovery.org/content/view.page.asp?I=1275 (accessed January 22, 2009).

[24] Richard B. Marth Sr., 1992. *GPS Army Research and Applications*. U.S. Army Topographic Engineering Center. http://handle.dtic.mil/100.2/ADA254262 (Information paper published at Fort Belvoir, VA. accessed on January 22, 2009): 5.

include an inability to acquire satellites on the receiver, the loss of acquired satellites, and inaccurate location data.[25] The problem inherent in GPS jamming is the relatively low power broadcast by GPS satellites. For comparison, a local FM radio station transmits approximately 100,000 Watts, a commercial cell phone tower approximately 800 Watts. The GPS satellite transmits at only 20 Watts. Compounding the low power of the transmitted signal with the 20,200 km distance of the MEO orbit GPS satellites, the resultant interference propensity is easy to see.[26] Major John Rayburn and Captain James Carson determined during their 2008 Master's thesis on GPS interference detection that this low power level was at the root of the problem behind GPS device susceptibility to jamming.[27] The element of uncertainty surrounding GPS enhanced tools is a significant concern for tactical commanders.

1. Blue Force Tracker

The key to a tactical commander's unprecedented situational awareness is Blue Force Tracker (BFT) and the variety of add-on software packages that enhance it. BFT takes positional data from GPS transmitted by friendly, or "blue," forces and displays them on a Common Operating Picture (COP) interface in command centers around the world. Other applications include the ability to send and receive messages and graphical overlays. BFT is a key ingredient in an overall Army system called the Army Battle Command System (ABCS).

a. Army Battle Command System

ABCS includes a series of information exchange subsystems such as Advanced Field Artillery Targeting and Direction System (AFATADS) and All

[25] John C. Rayburn and James E. Carson, 2008. *Design, Build, and Test a Hand-Held GPS Interference Detector.* Master's Thesis, Naval Postgraduate School: 11.

[26] Garmin Corporation, 2000. *GPS Guide for Beginners* (Garmin GPS user manual), Olathe, KS:5.

[27] Rayburn and Carson, 10.

Source Analysis System (ASAS). Inside Tactical Operation Centers (TOCs) from the Company level and up, the BFT COP is displayed through situational awareness systems. The most common Army system for TOC display is the Movement Control System (MCS) like the example shown in Figure 5. In Joint or Coalition operations, the Command Control Personal Computer (C2PC) is frequently used. Both C2PC and MCS provide command elements the ability to interact with and visually see BFT configured equipment in their area of operations.

Figure 5. Blue Force Tracker COP [28]
[From Army Battle Command System 6.4 Guide]

b. Force XXI Battle Command Brigade and Below

The individual Soldier interacts with the BFT system through the Force XXI Battle Command Brigade and Below (FBCB2). FBCB2 equipment, like those shown in Figure 6, and software are installed in individual HMMWVs, tanks, aircraft, and other vehicles. FBCB2 serves as the tactical unit's primary means of providing situational awareness to the overall commander as well as friendly units. Not only can commanders see with GPS accuracy where their Soldiers are, they can communicate via prioritized message traffic. The

[28] U.S. Army Central Training System Facility. 2006. *Warfighter's Guide to Army Battle Command System 6.4*: 49

combination of different system add-ons, ground level input devices, and sharing of data contribute to an overall picture that is critical to orchestrate operations on a twenty-first century battlefield.

Figure 6. FBCB2 configuration in HMMWV[29] [From Army Chaplaincy]

2. FA40 Role in PNVT

The FA40's role in GPS employment is seen in GPS accuracy predictions and BFT coordination. Ensuring operations are not impacted by GPS problems is accomplished predominately through access to the GPS Operations Center. The Operations Center, located at Shriever AFB, CO allows FA40s to contact the main control point for all GPS operations. From there, space operations personnel can get accuracy estimates and answers to technical questions on

[29] Eric R. Keller, 2002. Digital Transformation of the Army and the Unit Ministry Team. *The Army Chaplaincy. Summer-Fall*. http://www.usachcs.army.mil/TACarchive/ACsumfal02/ Keller.htm (accessed on February 2, 2009).

GPS applications. [30] BFT equipped devices have a transmitter onboard that transmits up to a commercial L-band satellite and then down to the ABCS. [31] ABCS maintains a connection with the Global Command and Control System (GCCS) via a secret network and feeds position data back to BFT users. The BFT-Mission Management Center (BFT-MMC) in Colorado Springs, CO manages the global BFT network. BFT-MMC serves as a collection point for space-based systems and provides the connectivity between tactical forces and strategic assets. The management center is operated by the SMDC and FA40s assigned to Divisions and Brigades contact them directly to troubleshoot problems with BFT. [32]

The ability to determine when jamming is occurring and finding methods to overcome it is a challenge for space operations officers and an area where the FA40 contributes to the tactical battlefield. Through coordination with the Space Battle Management Core System (SBMCS), predictions on the accuracy of GPS systems can be determined. [33] Even though technology advances have enabled the development of methods to defeat GPS jamming, the most effective means to counter jamming remains education. Knowledgeable FA40s working on the Division or Brigade staff use their understanding of space assets to alleviate problems and inform units how to overcome jamming effects. Often, GPS jamming problems go undiagnosed and result in nothing more than ill-performing GPS guided equipment. Space operations officers who are capable of identifying potential jamming events provide opportunities to the tactical unit to save

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[30] Space and Missile Defense Command, 2007. *FA40 Professional Reference Guide*: 7.

[31] Network Centric Warfare Case Study: Blue Force Tracker. 2006. http://www.carlisle.army.mil/usacsl/Publications/NCWCS%20Volume%201/13%20NCWCS%20Volume%201%20(Appendix%20D).pdf. Carlisle Barracks, PA (Accessed on January 22, 2009).

[32] FM 3-14, 2005.*Space Support to Army Operations*, Space and Missile Defense Command: II-4.

[33] Lenard Gehrke, 2008. *Global Positioning System. Space and Missile Defense Command* (Briefing posted November 2008 and accessed from Army Knowledge Online on February 2, 2009.).

equipment and conduct more effective operations.[34] PNVT is an area where space impacts may not be as evident as others, but the return on investment can be substantial if properly understood.

D. INTELLIGENCE

Since as early as the Civil War, the military has used high altitude vantage points to gain a strategic advantage over adversaries. In the Civil War the medium was balloons, in World War I, had biplanes were employed, and World War II, airplanes were used extensively to gather photo intelligence. Since the resources to gather this kind of intelligence were always limited, the customers were generally only the very high-ranking headquarters. As the intelligence gathering capabilities advanced from U-2 spy planes to Corona satellites, the customer remained strategic in nature. [35] Even as recently as DESERT STORM, the limited networks available to tactical commanders prevented them from being able to view imagery of any practical use. Modern Divisions and Brigades now have the ability, through the use of high capacity communications networks, to use timely imagery. The use of both national and commercial imagery systems make the planning of operations and assessment of effects available to levels that would not have been capable only five years earlier.

Space Operations Officers serve as the main point of liaison between intelligence staff elements in the G/S-2 and the archives of combined imagery banks and current resources. The way they accomplish this is through the use of critical points of contact within the imagery architecture and specialized equipment that enables access to products needed by tactical commanders. Key systems used at these levels include the Space Support Element Toolset, Division Tactical Exploitation System and the Digital Topographic Support System.

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[34] Bill Coffey, 2009 (comments noted during telephone conversation on January 2, 2009).

[35] Richard C. Olsen, 2007. *Remote Sensing from Air and Space*. Bellingham, WA: SPIE Press: 57.

1. Space Support Element Toolset

The Space Support Element Toolset (SSET) was first used "during the Army Transformation Experiment, MILLENNIUM CHALLENGE 02 in July 2002". [36] The SSET is a system with many sub components that each addresses a different element of tactical imagery access.

Initially, the SSET was equipped with the Broadcast Request Imagery Technology Experiment (BRITE). BRITE was a communications suite designed in a joint effort by the National Reconnaissance Office (NRO) and the National Geospatial Agency (NGA). During Army transformation experiments in 1998, the lack of bandwidth capacity in DESERT STORM era communications systems limited the use of imagery in tactical environments. This shortfall was addressed through BRITE's satellite communication capability and laptop computer loaded with imagery software. The communications system for BRITE was outside of the DSCS network and used Ka-band commercial satellites. [37] As satellite communications evolved, the BRITE system became less frequently seen in the SSET.

a. Space Operations System

SSET's are equipped with a Space Operations System (SOS) and Space Operations System Imagery (SOS-I) workstations. The SOS computers are Windows-based computers equipped with software that allows the use of a range of different space products. [38] The most current version, version v2+, uses a 3.8 Ghz processor, 2 GB RAM, and 256 MB NVIDIA GeForce 6800 Go Ultra video card.[39] Through the use of SOS's many components the system is

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[36] Debra Valine, 2004. "Battle Lab systems evolving to meet warfighters' needs." *Army Space Journal Fall 2004*. SMDC: 36.

[37] Jane's Information Group, 2001. *BRITE lights the way for small-unit intelligence imagery*. http://www.janes.com/extract/idr2001/idr00598.html (accessed January 23, 2009).

[38] Valine, 36.

[39] Tactical Space Operators Course, 2005. *Space Support Enhancements Toolset*. (Course presented December 2005 and accessed from Army Knowledge Online on January 23, 2009.)

capable of producing images and reports from national resources, analyzing reports on solar weather effects, GPS accuracy modeling, and providing missile defense launch and trajectory information as well as mapping support. [40]

The SOS system incorporates many common applications such as Microsoft Office and FrontPage, but space applications are what set SOS computers apart from typical workstations. There are common space applications such as Satellite Tool Kit (STK), but there are others as well. Space/Missile Analysis Tool and Space Common Operating Picture Exploitation System (SMAT/SCOPES) allow SOS to model orbiting objects and missile trajectories. [41] The Space Battle Management Core System (SBMCS) is a software package that integrates with the GPS constellation and STRATCOM databases to allow operators to see current satellite information. It uses regularly updated satellite ephemeris data to display where satellites are at given times. The SBMCS gives tactical commanders the ability to plan operations around enemy capabilities by knowing where and when friendly units are visible to enemy sensors. [42] The capability of the earlier generation BRITE system is also included through a BRITEVIEW software package (shown in Figure 7). Intelligence broadcasts on missile warning and situational awareness are available in near real-time through the Intelligence Situational Awareness Tool (ISAT).[43] Additionally, the SOS computers are capable of obtaining COP information from GCCS through the use of the BFT supported programs Command and Control Personal Computer (C2PC) and Maneuver Control

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[40] Future Warfare Center, *Space Operations System: SOS*. SMDC-FWC. http://www.smdc.army.mil/FactSheets/SOS.pdf (accessed December 30, 2008).

[41] Air Force Modeling and Simulation Resource Repository, 2007. *Air and Space Constructive Environment Integration.* https://afmsrr.afams.af.mil/index.cfm?RID=SMN_AF_1000106 (accessed January 23, 2009).

[42] LeRoy Pedone, 1999. *Integrated Space Command and Control*. USSPACECOM. http://sunset.usc.edu/gsaw/gsaw99/pdf-presentations/session-2/pedone.pdf (accessed January 23, 2009).

[43] Daryl Breitbach, 2008. *Army Space Support Team – Tactical Set: Overview*. SMDC. (Briefing presented for DCD training August 2008 an accessed via AKO January 23, 2009.)

System (MCS). [44] Imagery capabilities are also vital to SOS operations. The SOS computer runs several different image related programs and is capable of accessing archives for most commercial imaging satellites. Similar to many intelligence staff computers, SOS runs Falcon View for mapping and graphic overlays. To handle large images, SOS uses ELT/3500 image-processing software developed by Overwatch Textron Systems. [45] An integral part of the SSET, the SOS computer packs a lot of capability in an easily transportable package used by many Division space staff officers.

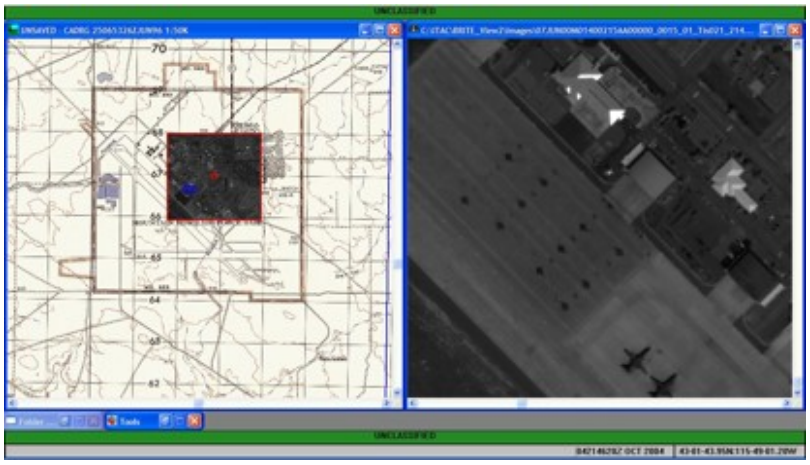

Figure 7. BRITEVIEW vs. 2.0 screen capture[46]
[From SMDC, Tactical Space Operators Course]

b. SSET Communication Subsystems

To solve the myriad communications problems common to remote tactical locations, the SSET employs International Maritime Satellite (INMARSAT) and the Space Applications Technology Research Network (SATURN). A 128 kbps INMARSAT terminal provides encrypted data and voice

[44] Tactical Space Operators Course.

[45] Overwatch Textron Systems, *ELT/3500 Product Overview*. Overwatch Company website. http://www.elt.overwatch.com/3500_overview.php (accessed January 23, 2009).

[46] Tactical Space Operators Course.

capability for system troubleshooting or additional capability. [47] Composed of commercial off the shelf (COTS) equipment, SATURN is a rapidly installable communications package designed to support the SSET for tactical locations. The system includes either a 1.2 or a 1.8 meter dish that can operate in the Ku and C bands, shown in Figure 8. The dish size is dependent on where on the Earth the dish will be installed. Communications throughputs of up to 9 Mbps downlink and 4 Mbps uplink are possible under the most ideal conditions, but around 2 Mbps is typical. An Internet Protocol Satellite (IPSAT) NetModem provides the SATURN with a link into the Defense Information Systems Agency (DISA) Commercial SATCOM Branch (CSB).[48] "The IPSET capability is the backbone of the SATURN's broadband communications."[49]

Figure 8. SATURN dish and black side transmission equipment[50] [From SMDC Briefing]

[47] Jeffrey Souder, 2003. "Space Support Element Toolset, etc: Rapid Prototyping Support to Army Space Forces." *Army Space Journal- Special Edition 2003*. SMDC: 22.

[48] Future Warfare Center, 2008. *SATURN: Space Application Technology User Reachback Node*. SMDC. http://www.smdc.army.mil/FactSheets/SATURN.pdf (accessed December 30, 2008).

[49] Ibid.

[50] Breitbach.

FA40s are the primary deployed users of the SSET. They support the commander and intelligence staff through imagery and other intelligence products. In addition, space status reports enable accurate planning for communications, GPS, and environmental impacts on operations. The SSET program, including both SATURN and SOS systems, is managed through the SMDC Operations Center in Colorado Springs, CO and FA40s contact the help desk 24 hours a day for assistance.

2. Division Tactical Exploitation System

A second major system in use supporting Division Commanders is the AN/TSQ-219 Division Tactical Exploitation System (DTES), shown in Figure 9. The DTES is a powerful tool that provides deployed Division Headquarters "the ability to process, receive, exploit and use intelligence".[51] Army Corps are configured with an AN/TSQ-210 Tactical Exploitation System (TES) that has six High Mobility Multi Wheel Vehicles (HMMWV). The DTES is a downsized version with reduced capabilities that is transported on two HMMWV shelters.

The DTES provides a one-stop resource for most of the G-2's intelligence requirements. Specifically, the DTES can receive SIGINT signals both directly and from other systems, process imagery from national systems, receive the Global Broadcast Service (GBS), monitor BFT data, transmit data on UHF and S-band frequencies, and integrate with Joint Surveillance and Target Attack Radar System (JSTARS) Moving Target Indicators (MTI). Only the TES has full connectivity with JSTARS, the DTES exploits MTI data only. Additionally, the TES can process raw IMINT and SIGINT while the DTES cannot.[52]

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[51] PEO IEW&S, *Tactical Exploitation System*. Army Space Program Office (accessed via AKO January 15, 2009).

[52] Ibid..

Figure 9. Division Tactical Exploitation System[53]
[From PEO IEW&S]

a. Tactical Exploitation System — Lightweight

Brigade Combat Teams can also be equipped with a TES family capability. The AN/TSQ-245 Tactical Exploitation System — Lightweight Intelligence Tactical Equipment (TES-LITE), shown in Figure 10, is a system transported in cases and designed for use in austere environments. Typically, BCTs, special operations forces, or other smaller units needing access to national system intelligence use TES-LITE systems. The TSQ-245 loses significant capability when compared to the DTES and even more compared to the TES. When taken into the proper context of previous BCT capabilities, it provides a service when there was none prior. TES-LITE cannot process SIGINT, access GBS, MTI data, or high bandwidth imagery products. Otherwise, it can do essentially what the DTES is capable of doing.

[53] PEO IEW&S.

Figure 10. TES-LITE system components[54]
[From PEO IEW&S]

b. TES Family Summary

The TES family of space-based intelligence equipment is normally operated by Army Military Intelligence specialties. However, the space-oriented nature of the equipment lends itself to FA40 involvement. Organizationally, the DTES and TES-LITE are assigned to the G/S-2 staff elements. DTES systems are currently fielded in six different Divisions: the 82nd Airborne Division at Fort Bragg, 3rd Infantry Division at Fort Stewart, 1st Infantry Division at Fort Riley, 1st Cavalry Division at Fort Hood, and two with the 25th Infantry Division at Schofield Barracks. [55]

3. Digital Topographic Support System

Terrain mapping and graphic products are extremely important to the Division and Brigade tactical commander's decision-making process. To ensure

[54] PEO IEW&S.

[55] Joseph Grebe, 2008. *TES Family of Systems Support" Distributed Common Ground System – Army* (Logistics Briefing June 2008 and accessed on AKO on January 26, 2009).

they have the imagery they need, the Digital Topographic Support System (DTSS) is fielded at the Theater, Division, and Brigade levels. Operated by Military Intelligence staff elements, DTSS comes in several types including the Base, Light, and Dismounted (DTSS-B, DTSS-L, and DTSS-D). The DTSS-B is used at Theater levels of command, while the DTSS-L and DTSS-D are used at Division and Brigade levels depending on unit mission requirements. The interior shelter space for the DTSS-L can be seen in Figure 11. Like the BFT system, DTSS is connected to the ABCS overall command and control network through the Distributed Common Ground System (DCGS). The main purpose of the DTSS family of systems is to provide on the spot reproduction of map-sized imagery from National systems as well as tools that combine digital terrain analysis with overlays. When equipped with the High Volume Map Production (HVMP) system, the DTSS can mass-produce up to 2,500, full color 22.5" x 29.5" imagery-based maps and products in a 24-hour period.[56]

Figure 11. DTSS-L Shelter Interior[57]
[From Fort Sill BCTC]

[56] Army Battle Command System Overview, Fort Sill Battle Command Training Center (Slides prepared for BCTC training and accessed from AKO on February 5, 2009): slide 63.

[57] Army Battle Command System Overview.

4. Other Space-Related Intelligence Systems

The synergistic relationship between Military Intelligence (MI) and Space requires frequent coordination and interaction. The products that G/S-2 staff elements require for Intelligence Preparation of the Battlefield (IPB) are often the result of FA40 and MI cooperation. The equipment that provides space products is generally operated by MI Soldiers and can provide a combination of intelligence and additional communications resources. The AN/TMQ-40 Integrated Meteorological System (IMETS) is an Air Force operated weather analysis tool. IMETS gives tactical commanders, down to the brigade level, the operational impacts of meteorological conditions for all phases of the battlefield including communications and mission support.[58] Finally, the AN/TSQ-190 Trojan Spirit II (TSII) communications assemblage, operated by MI elements, provides Ku band SATCOM up to the SCI level for intelligence network access. Although these systems are not operated by FA40s, they are Space related and they do contribute to the tactical commander's situational awareness.

5. External Capabilities and FA40 Role

The primary customer for imagery and other products provided from space systems is the G/S-2 intelligence staff element. Regardless of the type of equipment used to obtain the imagery, FA40s are often considered the chief provider and subject matter expert for imagery at the tactical level. Typically, the FA40 obtains products through portals accessed either through classified terminals or through some of the systems explained earlier. Several organizations, external to the tactical unit, provide additional capabilities from space.

[58] Terry Slayter, *New Material Introductory Briefing – IMETS. PEO C3T – Product Director Intelligence Fusion* (accessed from AKO on February 5, 2009).

a. Spectral Operations Resource Center

One of the key external resources for deployed FA40s is the Spectral Operations Resource Center (SORC). The SORC is a source of support in a wide range of remote sensing applications. It gives tactical units access to exploited spectral data from space and airborne sources. The tactical FA40 may request anything from maps, to spectral analysis, to terrain analysis products through the SORC. SORCs run operations on a twenty-four hour basis from Colorado Springs and can deploy small teams equipped with a vehicle-mounted capability. These deployable teams are assigned to the highest level of command involved in the task force and provide intelligence products where there is a combination of a justified need and a lack of organic capability.[59]

b. Commercial Exploitation Team

The new generation of commercial imaging satellites, with their improved resolution, has provided an additional resource for imagery intelligence. To take advantage of this extra capability, SMDC has developed the Commercial Exploitation Team (CET). A CET is a deployable unit with a staff of seven people that is controlled by the 2nd Space Battalion in Colorado. The two main assets the CET employs are the Spectral Exploitation Cell – Transportable (SPEC-TR) and the Eagle Vision ground station.

c. Eagle Vision Ground Terminal

The Eagle Vision terminal is a trailer mounted ground terminal, shown in Figure 12, developed by the Air Force that is capable of receiving a direct downlink from SPOT, Landsat, RADARSAT and OrbView commercial satellites. Recent satellites, such as Space Imaging's IKONOS and Digital Globe's Quickbird, are accessible through an extra communications system, but not as direct downloads. The complete 20-foot shelter assembly is capable of

[59] FM 3-14, B-14.

being transported in a single C-130 aircraft. Additionally, the Eagle Vision can interface directly with other military imagery systems such as DTSS. [60]

Figure 12. Eagle Vision deployable configuration[61]
[Unknown photographer from Flickr photo website
http://flickr.com/photos/45479866@N00/347837649]

d. Spectral Exploitation Cell — Transportable

SPEC-TR brings a capability to produce imagery products without other equipment. The SPEC-TR team can deploy without Eagle Vision when only spectral image production is required, but is dependent on other communications assets in that configuration. The two components combined,

[60] Rob Pietrafesa and Scott Matey, 2004. "Space experts provide warfighter access to commercial imagery." SMDC. *The Eagle* Volume 11, No. 7: 21.

[61] Eagle Vision demonstration photo (taken during U.S. Air Force Memorial Dedication and Pentagon Open House October 2, 2006 (accessed from http://flickr.com/photos/45479866@N00/347837649 on February 5, 2009).

however, enable the CET team to provide imagery exploitation capabilities and direct access to commercial satellites in a tactical environment.[62]

e. Commercial Imagery and Tactical Space

In a time of increasing need for imagery products, skyrocketing costs of national systems, and improvements to commercially available resolution the CET provides a viable alternative source for near-real time intelligence. Despite the additional resource, there are concerns with the use of commercial imagery for tactical use. Specifically, when a commercial system such as IKONOS or Quickbird is keyed to provide access to a certain position within a certain timeframe it can be an indicator of U.S. intentions. When added to other factors it allows a potential adversary to see an area the government is targeting. There are mitigation efforts to minimize this effect, but it is a contributor to an overall picture of U.S. operations. Commercial assets, however, provide a significant addition to other existing systems and can often assist when other resources cannot. For example, a beneficial artifact of using commercial images can be seen in the ability to share with coalition partners. Images downloaded from commercial sources can be shared more freely in a NIPRNET domain.

6. Capabilities Summary

The resources available to a modern tactical commander are astounding when compared to those of early commanders. The same questions are being asked today that were asked 2000 years ago, but technology enables a much broader situational awareness. The real dividing line between an ancient battlefield commander and a modern tactical commander is the span of their environment and the tools that provide control.

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[62] FM 3-14. B-15.

Army Division and Brigade Commanders have exceptional tools to measure and monitor situational awareness. Key among the tools are Space-based ones that showcase primarily imagery. A palette of tools such as SSET, with its SATURN communications and SOS workstation, or the DTES, with its interoperability with other systems and reachback capability, are important to get an overall picture of what is available. In addition, external resources such as the SORC and CETs available through SMDC and the 1st Space Brigade provide a high level of expertise all the way down to the battlefield command. The power of this ability to deliver strategic quality products and knowledge to the tactical level enables capabilities that far exceed the typical. Deployability of many of these resources extends the reach dramatically and provides the best Space-based products possible in a timely enough manner to impact decision making at the tactical level. Through these vital partnerships with SMDC, MI forces, the Air Force, and the commercial satellite industry, the FA40 is capable of providing many critical products that influence both operations and doctrine.

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III. ARMY TACTICAL SPACE MANNING

A. ARMY SPACE HISTORY

October 3, 1957, is generally considered the birth date of Army Space. On that date, the Redstone Anti-Missile Missile Systems Office opened in Huntsville, AL. Coincidentally, the Russian Sputnik launch occurred one day later on October 4, 1957. Although it became significant later, the concept of "tactical space" was not the focus of Army space efforts at the time. The emphasis was primarily on missile defense and global communications. [63] As time marched on and satellite applications crept into many different areas of defense, the Army was forced to move beyond merely missile defense and communications. The escalating importance of Space forced the Army to reconsider their role and, by 1984, began research into possible applications. Between 1986 and 1998, the Army honed many methods and products to deliver Space into tactical commanders' hands. It is during that time of experimentation that the Army Space Support Team (ARSST) was developed to provide that expertise.[64]

As Army warfighting commanders gradually understood what space provides the battlefield, the necessity became more critical. During the Cold War space access was primarily a strategic resource. As technology embedded into frontline units Space capability evolved into a key aid for planning operations and situational awareness at the tactical level. In order for the benefit to be more widespread, tactical units needed to be capable of accessing Space assets on a routine basis. The Space-based products began to be available at lower levels of command and tactical commanders started to learn how they fit into the planning process, albeit with some reluctance. This resistance to the use of

[63] Kevin T. Campbell, 2008. "50 Years in Space." *Army Space Journal Winter Ed*. 7(1): 4.

[64] Lewis Berstein, 2005."Army Space Support Teams: The Early Years 1986-1998." *Army Space Journal Winter Edition*: 1F.

Space products was based on a lack of understanding of what they provide and how they work. Space smart staff officers were not readily available in the early iterations of tactical Space.

"In 1998, the Army recognized the need for a cadre of Space Professionals who were specifically trained in and knowledgeable of Space-based capabilities and their employment in support of the Warfighter."[65] It was through this desire to provide space support to all appropriate levels of the Army that the Functional Area 40, Space Operations Officer concept was developed. SMDC is tasked with the responsibility of managing the FA40 career field due the extremely specialized nature of the occupation. Initially, FA40s were primarily seen in Joint space locations with only 50 billets in U.S. Space Command, North American Defense Command, and the National Security Space Architect Office.[66] As an extension of the FA40 development, the placement of FA40 officers into tactical units as organic members became useful. This step was attempted initially in 2001 with the 10th Mountain Division and demonstrated the origin of the Space Support Element (SSE). [67] The ARSST and SSE represent the two primary vehicles through which the Army provides FA40 expertise within today's tactical staffs. The role and design of each will be covered in more detail.

B. ARMY SPACE SUPPORT TEAMS (ARSST)

The establishment of the Army Space Institute in Fort Leavenworth, KS in 1986 was a key moment in the evolution of the ARSST. The Institute focused on Army Space doctrine, concepts, training and equipment with an ultimate purpose to educate the Army on the benefits of Space. Through extensive experimentation and demonstration, the Institute exposed Soldiers to space capabilities. Support of operations in Saudi Arabia in 1990 and 1991, Haiti in

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[65] Campbell, 10.

[66] Ibid., 11.

[67] SMDC, 2006. *US Army Space Support Element (SSE) History 1998-2006. From Concept to Combat Capability* (SMDC briefing conducted 2006 and accessed from AKO December 19, 2008).

1994 and 1995, and Bosnia from 1996 to 1998 exposed tactical commanders for the first time to what Space can provide.[68]

> The first Gulf War of 1990–1991, often referred to as the First Space War, demonstrated the benefits of Space capabilities on an actual battlefield to both Soldiers and commanders. In the deserts of Saudi Arabia, Kuwait and southern Iraq, the Army was exposed to the value of multi-spectral imagery, Global Positioning System position/navigation, satellite weather, ballistic missile warning and satellite communications.[69]

That "First Space War" may highlight the incredible benefits of Space, but it also highlights a culture of misunderstanding. Tactical commanders and staff had very little understanding of how the Space assets worked or even what they could provide. In order to ensure effective use of Space, the Army developed the first space support team known as Contingency Operations-Space (COPS) in 1994. The intent of COPS was to deploy teams from Colorado Springs to support Army operations worldwide. By the beginning of 1995, the COPS concept evolved into the ARSST and began supporting exercises. ARSST teams supported 28 exercises in 1995 and began supporting worldwide operations in 1996 starting with the 1st Infantry Division in Tuzla, Bosnia. The most common customers for ARSST services were the XVIII Airborne Corps out of Fort Bragg, NC and Army Special Operations. The development of the FA40 community was in large part connected with the newfound need to provide trained and knowledgeable personnel to operate ARSSTs.[70]

The ARSST structure falls within SMDC as shown in Figure 13. The 1st Space Brigade, headquartered in Peterson AFB, CO and its subordinate 1st Space Battalion are responsible for the training, equipping, and deployment of ARSSTs. [71] Within the 1st Space Battalion are the 1st, 2nd, 3rd, 4th, and 5th Space

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[68] Bernstein, 1F.

[69] Ibid.

[70] Ibid.

[71] Karen Butler, 2004. "New Colors, New Era for 1st Space Battalion." *Army Space Journal Fall Edition*: 38.

Companies. The 1st Space Company is responsible for theater missile warning through the six JTAGS stations located in Qatar, Germany, Korea, Colorado Springs, and Fort Bliss, TX. The 2nd Space Company consists of six active duty ARSSTs and one Commercial Exploitation Team. The 4th Space Company is a Space support unit. The 3rd and 5th Space Companies are Army Reserve units consisting of ten ARSSTs and one CET. In addition to the 1st Space Battalion, the Colorado National Guard's 117th Space Support Battalion also consists of ARSSTs. The 117th includes eleven ARSSTs and one CET. There are 27 total ARSSTs and three CETs available Army-wide through the 1st Space Brigade and SMDC.[72]

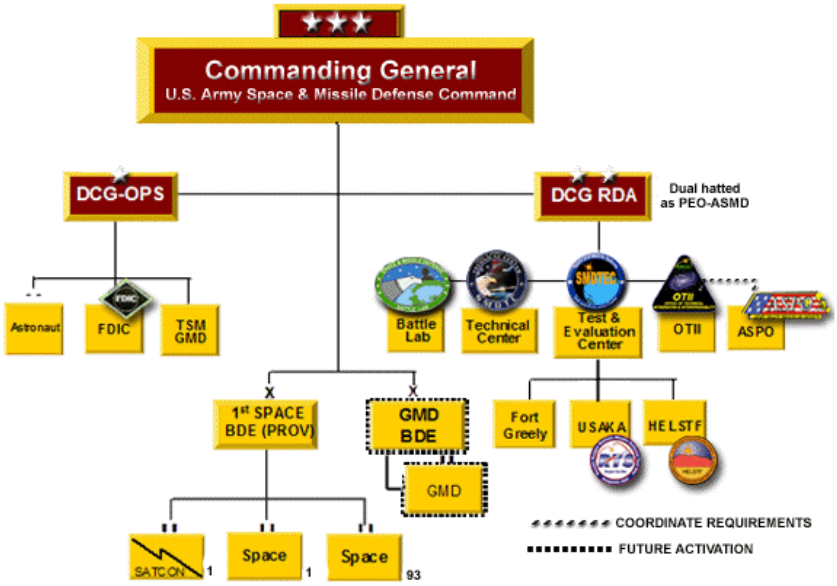

Figure 13. SMDC Organizational Structure[73]
[From Global Security]

[72] Jeff Farnsworth and Rich Lewis, 2008. *Evolving Our Operating Concepts Optimize Current & Enable Emerging Capabilities. 1st Space Brigade* (Briefing conducted at FA40 Symposium 2008 and accessed from AKO February 3, 2009).

[73] 1st Space Brigade, GlobalSecurity. http://www.globalsecurity.org/space/agency/1space-bde.html. Accessed on January 2, 2009.

The purpose of the ARSST is to provide Space-based capabilities to units with either no existing or insufficient organic capability of their own. The ARSST mission statement states they "plan, coordinate, integrate, and synchronize the execution of the five Space Force Enhancement Functions[74]:

- Early warning
- Satellite communications
- PNVT
- Weather, terrain & environmental monitoring
- Intelligence, surveillance, and reconnaissance

Specialized equipment combined with the space expertise of the ARSST personnel provide the power behind the ARSST capabilities. Similar to the SSET explained in the capabilities section, the ARSST teams deploy with an Army Space Support Team Tool Set (ARSST-TS). The ARSST-TS consists of two SOS terminals and a SATURN system. The system can be deployed dismounted or mounted inside a HMMWV shelter and is tailored to the needs of the supported unit. The ARSST personnel breakdown consists of six Soldiers with varied skills that are attached to the unit in the best method to support operations.[75] A representative example is shown in Figure 14.

Title	*MOS*	*Rank*
Space operations officer	40A	O4
Space operations officer	25C	O3
Intelligence analyst	96B	E6
SATCOM systems operator	31S	E5
Topographic analyst	81T	E5
Information systems operator-analyst	74B	E4

Figure 14. ARSST Team Composition[76]
[From FM 3-14]

[74] SMDC, ARSST Companies in the 1st Space Battalion (briefing given during 2004 AUSA seminar an accessed from AKO on February 3, 2009).

[75] FM 3-14, C-2.

[76] Ibid.

C. SPACE SUPPORT ELEMENT (SSE)

Beginning in 2000, the Army underwent a period of dramatic transformation. The result of the transformation was a radical change in the formation of Army units spurred on by the events of September 11, 2001. The rigid Division and Brigade structures of the past were redesigned into a modular force. The goal of the new "modularity" was to build a stable of equally versatile brigade sized units called Brigade Combat Teams (BCT) that are each capable of being used to accomplish a wide range of missions. BCTs were designed to report to a Division or Corps level headquarters called a Unit of Employment (UE). The structure of the BCT retained a connection to the Division they are historically part of, but could be called upon to operate autonomously or in a team of BCTs working in unison under a UE.

As the ARSST teams continued to deploy in support of Divisions, the push towards modularity begged the question of whether BCTs and UE headquarters needed space support too. During an exercise called Millennium Challenge (MC00)/ Joint Contingency Force Advanced Warfighting Experiment (JCF AWE), the FA40 community experimented with the placement of FA40 Space Operations Officers within Division headquarters. Captain Bill McClagan served as the 10th Mountain Division's first organic Space Operations Officer. Captain McClagan was assigned to the Division G3 staff for the exercise located in Fort Polk, LA. [77] The outcome of the experiment was a desire by the Division staff to retain space expertise as a permanent resource. During the Interim Division Redesign Conference in October 2001, the Army coined the term Space Support Element (SSE) to symbolize the organic space team. The purpose of the SSE was to provide the same expertise provided by the ARSST, but on a full-time basis. [78]

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[77] SMDC, 2006. *US Army Space Support Element (SSE) History 1998-2006: From Concept to Combat Capability* (brief, Peterson AFB, CO, October 2006): slide 4.

[78] Ibid.

Figure 15. First SSET used for MC02[79]
[From SSE History]

By August 2002, the first experimental SSE was ready to test the first SSET in a tactical setting, shown in Figure 15 above. The 82nd Airborne Division from Fort Bragg, NC conducted Millennium Challenge 2002 (MC02)/ Army Transformation Experiment 2002 (ATEx02) to see what an SSE with space tools could provide a Division headquarters. Major Dave Hotop led the first SSE through MC02/ATEx02. The results of the first SSE experiment were considered successful and the Army deemed the SSE a valid part of the Modified Table of Organization and Equipment (MTOE) for Division sized units in 2003. By 2004, the first completely organic SSE was assigned to the 3rd Infantry Division at Fort Stewart, GA. [80] Tables 1 through 5 depict the basic structure for various SSEs.

[79] SMDC, 2006, slide 4.

[80] Ibid.

Corps SSE

Title	***MOS***	***Rank***
Space Support Element Chief	40A	O5
Space Operations Officer	40A	O4
Space Operations Officer	40A	O4
Satellite Communications Systems Operator	25S	E6
Satellite Communications Systems Operator	25S	E6

Table 1. Corps SSE Team Composition

Division SSE

Title	***MOS***	***Rank***
Space Support Element Chief	40A	O5
Space Operations Officer	40A	O4
Satellite Communications Systems Operator	25S	E6
Satellite Communications Systems Operator	25S	E6

Table 2. Division SSE Team Composition

BCT SSE

Title	***MOS***	***Rank***
Space Operations Officer	40A	O4

Table 3. BCT SSE

There are ten SSE teams currently assigned to ten active duty Division headquarters. Additionally, eight National Guard divisions are equipped with SSEs. A complete roster of SSEs available across the Army includes three at Corps level and seven at the Army level. As the development of the SSE evolves, the structure of the teams evolves also. Currently, the only Division SSE containing enlisted members is the 1st Infantry Division, with all others having either two or four FA40 officers assigned.[81] The layout of personnel within both active duty and National Guard Divisions can be seen in Tables 4 and 5.

[81] Bill Coffey, 2008. *SSEs Authorized by MTOE*. SMDC (spreadsheet obtained via email from SMDC Future Warfare Center).

Active Duty Divisions Authorized SSEs	***Total Personnel***	***Notes***
1st Armored Division	2	only officers
1st Cavalry Division	2	only officers
1st Infantry Division	4	
2nd Infantry Division	2	only officers
3rd Infantry Division	2	only officers
4th Infantry Division	4	only officers
10th Mountain Division	2	only officers
25th Infantry Division	2	only officers
82nd Airborne Division	2	only officers
101st Airborne Division (Air Assault)	2	only officers

Table 4. Active Duty Division SSEs[82]

National Guard Divisions Authorized SSEs	***Total Personnel***
28th Infantry Division	2
29th Infantry Division	2
34th Infantry Division	4
35th Infantry Division	2
36th Infantry Division	2
38th Infantry Division	4
40th Mountain Division	2
42nd Infantry Division	2

Table 5. National Guard SSEs[83]

The mission of the SSE is to serve as the assigned unit's chief proponent of Space. They provide a point of liaison between the Division and reachback capabilities for Space-borne resources ranging from the National Geospatial Agency (NGA), to the National Reconnaissance Office (NRO), to the SMDC support infrastructure. FA40s assigned as SSEs develop Operations Order

[82] Coffey.

[83] Ibid.

Space Annexes, contribute to planning, and provide input into Space Intelligence Preparation of the Battlefield, PNVT, BFT, and satellite communications systems employment. [84]

Space Operations Officers assigned as BCT SSEs serve the same purpose as the Division counterpart, but on a smaller scale. The long-term plan for BCT SSEs is to field one FA40 for every one of the 15 Future Combat System (FCS) capable BCTs. As of 2009, only five BCTs include FA40 officers. In the next section, the utility of the BCT FA40 will be explored in detail.[85]

D. SUMMARY OF PERSONNEL

The development of ARSST, SSE teams and the FA40 all demonstrate the Army's desire to provide space capabilities to tactical commanders. The evolution of the FA40 from a small group of specialized officers to a formal functional area complete with organizational training courses and equipment sets is analogous to the formation of either incarnation of space skilled teams (SSE or ARSST). The ARSST and SSE began with groups of officers from mixed backgrounds who brought non-doctrinal skills to accomplish missions that did not fall under the responsibility of any one branch. As the complexity of space products and the desire for them progressed, the non-doctrinal approach began to be less advantageous. Similarly, the FA40 community began with a pool of officers that had obtained space-skills outside of their doctrinal duties, but those skills were not standardized and varied greatly from individual to individual. The ARSST and SSE teams addressed the shortfall from an operational perspective, but to satisfy the new, space-based mission areas from a staff position perspective the FA40 career field was developed. The genealogy of the FA40's

[84] Jim Rozzi and Bill Coffey, 2008. *SSE Mission*. SMDC (obtained via email from Bill Coffey, SMDC Future Warfare Center on January 2, 2009).

[85] Bill Coffey, 2009 (phone conversation with SMDC FWC Training Proponent Bill Coffey on January 2, 2009).

existence as a functional area can be traced through both the ARSST and SSE, for without the first ARSST the impetus for an SSE would not exist and further the necessity for the FA40.

FA40 officers serve as commanders of both team variants. The main difference between an ARSST and a SSE is that the former works for the 1st Space Brigade and is loaned to tactical units while the latter is a permanent part of the tactical unit. There are inherent benefits and limitations for both teams. Clearly, there are applications for either, demonstrated by the fact that the numbers of ARSSTs has grown from initially only a couple to almost 30 currently, and that FA40s continue to be assigned to SSEs within the ten Division headquarters.

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IV. ORGANIZATIONAL STUDY

A. OVERVIEW

1. Modularity and Impact on Space Forces

Space Operations Officers remain a relatively recent development in the Army force structure. Having only existed formally since 1998, there is still much to discover in finding the proper methods to apply their skills. In the wake of transformational change within the Army, the application of Space as a resource is often overlooked. The Army seeks to achieve modularity but many Army leaders and planners do not fully understand the contributions of Space to the warfighter. The instinct by many leaders is to apply a "pure-modularity" technique. This means that each Division or BCT has a slice of every applicable specialty within the unit whether the unit has a legitimate need or not. The danger in such an approach is that many specialties lose touch with technology and tactics associated with their field. When the organic unit does not understand what the Soldier provides and the Soldier cannot promote their contribution effectively, they are often utilized in other areas needed by the unit. This can result in a reduction of perishable skills, which not only reduces the capabilities of the organic unit, but the Army as a whole. The application of FA40s throughout the Army falls under this category. One method to prevent misapplication of FA40s is to involve members of the space professional cadre in the decision making process where possible. LTC Clay Scherer states in his 2005 Master's thesis Army Space and Transformation that if Space is to "play a key role in the Transformed Army" Space educated individuals "must be embedded in the force structure development process." [86]

[86] Clay Scherer, 2005. *Army Space and Transformation*. Naval Postgraduate School Master's Thesis, 36.

2. Analysis Method

Creating a more efficient FA40 distribution involves FA40 inclusion in the development process, determining the current configuration, analyzing effectiveness of the current configuration, and designing a better method. The first step is crucial. Justifying to the upper leadership the criticality of Space-capabilities is important to ensure issues are heard at high enough levels. Second, an accurate picture of how FA40s are distributed throughout the organization is necessary to give a baseline measurement. Using planning and assessment tools, determining the usefulness of the current configuration is possible. Finally, analyzing available alternatives and recommending a more logical way can help chart a course to a more effective force. The next sections will summarize these factors individually.

3. Justifying Space to the Army

In order to ensure the FA40 functional area continues to grow and develop some salesmanship is needed on both the organizational and the unit levels. LTC Scherer's insights into the connection between Army capability gaps and Space capabilities are an excellent place to start. The Army used these capability gaps to determine transformational impacts on the Future Force, so using them to demonstrate where Space can help overcome existing gaps is appropriate. On a unit level, the individual FA40 must ensure they understand where Space can contribute to the unit. Potentially, these contributions may not be immediately discernable and are heavily reliant on the abilities of the FA40. [87]

4 FA40 Current Utilization

FA40s are assigned at several levels of Army command. Just as a preliminary examination, approximately 54% of active FA40s are assigned to Joint, Strategic, or Army level units. Of the remaining 46%, 17% work within the

[87] Scherer, 40.

1st Space Brigade and 24% work at Corps or below Space Support Element jobs. The remaining 5% work at various branch immaterial positions unrelated to space. [88] This is a cursory look at distributions; in a later section, they will be examined in much more detail.

5. Effectiveness Study

An ideal way to examine the issue of FA40 utilization is to study applications and resources in terms of DOTMLPF. DOTMLPF is a military planning assessment tool that stands for Doctrine, Organization, Training, Material, Leadership, Education, Personnel, and Facilities. The purpose behind DOTMLPF is to provide a template to be used when studying a new program or system. The DOTMLPF ensures that all of the major sections are included in any study. In terms of FA40 utilization throughout the Army, DOTMLPF provides a sound baseline to begin a study.

6. Better Methods

To provide the Army with the most effective cadre of Space Operations Officers, some modifications must be made to the current system. One of the most integral factors in redesigning the space force is the training of the rest of the Army. Rather than spreading FA40s throughout Divisions and BCTs where they have limited contact with Space elements, the concept of leaving them within the 1st Space Brigade provides consistent Space education and cross fertilization of Space knowledge. Space applications at definitely the BCT level, and likely the Division level, are generally little more than using web-based applications and software packages. Those skills are mainly only applied during deployments. Training resident G/S-2 staff or G/S-6 staff members how to accomplish these tasks on their own ensures they are available for necessary missions.

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[88] SMDC, FA40 Roster version 2.51 (spreadsheet obtained from Bill Coffey via email dated December 4, 2008).

B. SPACE ROLE IN ARMY TRANSFORMATION

1. Army Campaign Plan

As explained earlier, transformation of the Army's organizational and operational structure is a significant evolutionary step for the Army. The Army Campaign Plan (ACP) is the Army's plan to achieve this transformation. In 2004, the National Military Strategy describes a desire for the DOD to become more combined, adjustable, and decentralized while at the same time increasing battlefield capabilities. The Quadrennial Defense Review of 2006 expresses a fresh view of Soldier skills with an extremely flexible fighting force that is capable of moving from one kind of mission to another without losing special skills.[89] The plan outlines a modular force with maximum capabilities combined into smaller, more mobile packages that can interact with other packages in a Joint environment.

This directive is the FA40's main point of interaction with the overall Army planning structure. Although SMDC is also instructed to complete tasks relating to missile defense and high altitude operations there are specified space-related objectives as well. In terms of space, the plan directs SMDC to:

Continue efforts to ensure Space Superiority.

Assist the G-3/5/7 and Training Doctrine Command in the development and refinement of Space related Force Design Updates.

Continue to develop Space professionals and assist G-3/5/7 in the identification of Space Cadre positions and enablers.

Develop and transition advanced technology to provide material solutions to the current and Future Force.[90]

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[89] Office of the Deputy Chief of Staff, G-3/5/7.Army Campaign Plan 2008 EXORD – Unclassified excerpt only (June 16, 2008): (accessed from Army Knowledge Online on February 14, 2009): 3.

[90] ACP EXORD, 38.

The ACP serves as the driver behind the transformation towards a modular and effective fighting force. Modularity, in terms of the ACP, means to build Brigade sized elements with multiple applications that can have an impact in any scenario. An estimate for final conversion of all Army Brigades to modular BCTs is 2013.[91] As the Army continues towards this end state, it is vital that the FA40/Space proponent, SMDC, is involved in the development process. Involvement ensures that the requirements to sustain the capable Space Force do not become lost in the overall push to transformation. Attempting to make every specialty fit into modular blocks may have long-term implications in the health and effectiveness of low-density skills such as Space.

The plan instructs SMDC to not only ensure space superiority for the Army's space applications; it also directs several system acquisition based elements. Force design and material solutions imply a connection to acquiring new space-based systems. Although there are no FA40s at the Division or Brigade level making decisions in regards to new space systems, there are many positions within SMDC that do. One current gap, and therefore potential area for improvement in FA40 utilization, is the lack of a permanent acquisition specialty. The same FA40 personnel who are assigned to a Division SSE for one rotation may be in an acquisition related position for a subsequent tour. This has little impact on Division and Brigade elements, but does play a role in the overall utilization of FA40s. The result of having no permanent acquisition specialty is that there are no experts over the long term in regards to Army space applications. Despite many programs of record that provide space capabilities to the Army, there are no full time, space educated personnel managing them. There are Army Acquisition Corps officers working space issues with specialized training such as the 3-Yankee skill identifier, but there are no full time FA40 acquisition personnel. I propose a more effective means of managing the Army's space programs through the use of an FA40 Space Operations Officer as a trained acquisition professional. FA40s in acquisition heavy jobs are already

[91] ACP EXORD, 8.

doing the work, but they may not have the time to develop competence before being assigned for other duties. A permanent cadre of space acquisition professionals ensures excellent oversight on all of the Army's many space-based programs.

2. Units of Transformation

In the 2000 version of the Army Space Master Plan, it was advocated to have organic Space staff within Corps and Divisions. Prior to this, Space support for these units was exclusively ARSST teams deployed when support was requested. That plan seeks an end state for space as being a normal and organic element within the tactical unit. [92] Initially, Division level staffs are as low as organic FA40 support is recommended to be fielded, but demand to add BCTs to the list has escalated.

The BCT is the building block of Army modularity. Based on the 2009 end strength of 235 active FA40s, fielding an SSE in every one of the 48 active BCTs is unrealistic and untenable. Instead, the decision is made to support some FA40s in Fires BCTs. The Fires BCT experiment has been met with limited success and will be covered in greater detail in the assessment section. The long-term goal is to place an FA40 on the staff for every Future Combat System (FCS) equipped BCT with the Fires BCT serving as a stepping stone.[93] The FCS BCT is a modernization program that showcases many high-technology capabilities such as fully networked vehicles, the Joint Tactical Radio System (JTRS), advanced sensors, Unmanned Aerial Vehicles (UAVs), as well as unmanned ground vehicle capabilities.[94] The FCS BCT is currently under program development and designed to provide advanced capabilities to tactical

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[92] Department of the Army, United States Army Space Master Plan, SMDC (Washington, D.C.: US Government Printing Office, 2000): 11.

[93] Bill Coffey (phone conversation January 2, 2009).

[94] Program Manager FCS Brigade Combat Team, 2007. *FCS 101 Employee Orientation* (briefing given to civilian PM employees on March 5, 2007 and accessed via AKO on February 14, 2009).

units. An Enhanced-BCT (E-BCT) is currently testing unproven and unrefined technologies with procurement scheduled to begin in 2010, followed by fielding and delivery of equipment in 2011. [95]

Currently, both ARSST teams and SSEs fulfill Army Space tactical requirements. ARSST teams are requested by units based on an "as needed" basis and typically are assigned to Theater, Joint, or other less standardized organizations. Since the introduction of SSEs into Divisions, there has been less ARSST support for Division levels. It is not, however, impossible for a Division with an SSE to request ARSST support if the mission warrants it. Space support for tactical units is a vital part of the Space Force's contribution to the overall Army mission.

3. Comparing Capability Gaps to Space Capabilities

In his Master's thesis, LTC Scherer points out several areas where Space capabilities can address existing Army shortfalls. The identification of these areas of impact is important to the overall relevance of space in the Army's transformation into the Future Force. The side-by-side comparison of these capability gaps with the Army space capabilities that address them can be seen in Table 6. This is, in essence, how the Space force justifies its value to the Army.

[95] John Bartley, 2008. *Spin Out Early Infantry Brigade Combat Team Acquisition Strategy. Program Manager FCS (BCT)* (briefing presented 2008 and accessed via AKO on February 14, 2009).

Army Capability Gap	Space Capability
Soldier Protection	Missile Warning, Space Control
Effective Command and Control	SATCOM, PNVT
Platform Protection	Missile Warning, Space Control
Uninterrupted C4 Architecture	SATCOM, PNVT
Modular, Tailorable Forces	Army Space Cadre
Capability for Lethal Overmatch	SATCOM, PNVT
Enable the Army to Train as it Fights	SATCOM, PNVT
Provide ISR Capabilities	ISR platforms, Weather Monitoring
Provide Capability to Detect and Identify Obstacles	ISR platforms, Weather Monitoring
Provide Logistics to Sustain Modular Force	SATCOM, PNVT

Table 6. Space Capabilities Compared to Gaps[96]

The use of ARSST and SSE forces demonstrates the customer side of space support. The tools, training, and equipment provided through SMDC demonstrate the larger, organizational view of space support. The combination of the two is how the Space Force accomplishes these tasks. SMDC builds priorities from the capability gaps in order to ensure mission accomplishment. The ability to link capability gaps with space capabilities and then with space priorities is critical in establishing space as a legitimate partner for developing future plans.[97]

There is little dispute that space products are valued by tactical commanders, but the methods through which they are provided is more ambiguous to those same commanders. Very few have a comprehensive understanding of space assets and how they work. The complexity of space problems has typically been the justification for the presence of space staff officers on tactical staffs. The commander understood they needed the products, but did not want to invest time into how they were obtained. Looking at this problem from an organizational view, space products could theoretically be

[96] Scherer, 41-42.

[97] Ibid., 42.

provided by any staff officers with a rudimentary knowledge of the required systems. The commander is generally more interested in final products than processes. Frequently commanders have retained space staff more out of fear of losing personnel than in actually requiring the space expertise. This issue is at the heart of FA40 utilization in Division and Brigade elements. From the Army organizational level determining the structure of future Armies to the local tactical commander determining how best to utilize his staff, understanding how space impacts operations is the first key step in carving out the future of the space force. Some important questions to ask as development continues to evolve are:

— What is the real contribution of space at the tactical level?

— Do FA40s provide exclusive services or do they merely augment other staff sections?

Educating upper echelon command, planners, and doctrine developers is very important to set the stage for future space forces. Instructing leaders in orbital mechanics and complex satellite operations is not necessary. More important is a cursory understanding of how the unit on the battlefield can best accomplish its mission over the long-term using space assets. Often, the answer has been to solve the problem by putting space educated professionals at lower and lower levels of command. Perhaps educating staff to obtain space products on their own and educating leaders on realistic expectations is an alternative solution. Space professionals are needed in tactical environments to provide specialized services, but education for staff and commanders would enable a broader reach for space enabling technology. Broader reach ensures more levels of the Army can take advantage of the tremendous advantages available through space.

C. FA40 DISTRIBUTION

As of December 2008, there are 235 FA40s currently assigned within the Army. An overwhelming 76% of all FA40s are assigned outside of the SSE structure. The remaining 24% - 13 Lieutenant Colonels, 30 Majors, and 15 Captains - work within an SSE at some level. Table 7 displays the number of FA40 Lieutenant Colonels, Majors, and Captains both authorized and available across the Army.

	Authorized	Available	Percentage
LTC	63	59	94%
MAJ	93	115	124%
CPT	24	38	158%
Total	180	212	118%

Table 7. FA40 Authorizations[98]

Although the apparent percentage of available FA40s appears to be highly over strength, the chart does not reflect the numbers of FA40s that are not serving within the FA40 functional area. Reasons why an FA40 may not serve within the functional area include attending advanced graduate education, working with industry, or having been accepted into the FA40 branch and awaiting release from the former branch. A more accurate depiction of the FA40 strength can be seen in Table 8.

	Authorized	Working in FA40	Working outside FA40	Percentage
LTC	63	57	2	90%
MAJ	93	94	21	101%
CPT	24	16	22	67%
Total	180	212	45	93%

Table 8. Functional Area Percentage[99]

[98] Alan Hughes, 2009. *FA40A Strength* (spreadsheet provided by FA40 Proponent Office).

[99] Ibid.

Taking into account the actual FA40s serving within the space cadre, the numbers still appear to be healthy overall. A small deficit exists for Lieutenant Colonels, but a much larger one exists for the Captain level FA40. A main reason for this discrepancy is the accession process of new FA40s. When an officer is converted into an FA40 they may continue to work in their former field for several years. Once accessed into FA40 they still must complete any tour or payback requirements for their old branch before being released. Also not mentioned in the chart is the status of Colonel FA40s. The Army maintains 13 Colonel positions for FA40s, but has an inventory of 19 as of February 2009.[100]

There are two alternate groups that work in the space and satellite field other than FA40s. The 3-Yankee (3Y) identifier and several enlisted specialties add to the Army's overall space picture. Both contribute in different ways, but act to provide depth for the space cadre.

Developed in 1985 to satisfy the need for space-educated individuals to accomplish space related missions, the 3Y identifier is an extra skill that many in the Army are capable of earning. The concept of the 3Y serves to provide formally trained and certified space professionals that are not FA40s to augment the Army Space Cadre. As discussed earlier, an example of 3Y utilization is found in the Acquisition Corps personnel who oversee space programs. To obtain the 3Y identifier, individuals must complete a 108-hour space course, work in a space related field for a minimum of one year, or possess a degree in space that is validated by the 3Y approval authority. [101]

The numbers of 3Y positions within the Army has shifted over time. As the FA40 career field developed, the number of 3Y trained personnel dropped from a high of 700 in 2000 to 503 in 2009. Since the 3Y was designed to fill space related positions, it is only natural that FA40 growth has a reciprocal

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[100] Alan Hughes, 2009 *(obtained from direct email correspondence with FA40* Proponent Office on March 11, 2009).

[101] FA40 Proponent Office, *What is Skill Identifier 3Y?* Human Resources Command. http://www4.army.mil/FA40/skillid.php (Accessed on February 26, 2009).

relationship with 3Y manning. Despite the fact that there are 513 available 3Y personnel within the Army in 2009, there are only 171 authorized positions. A modest increase to 176 positions is planned in 2010. [102] The future role of the 3Y seems uncertain as the numbers of FA40s continues to climb.

Enlisted personnel working to support the Army Space Cadre are generally considered to be "Space Enablers". They augment the FA40 force and help accomplish the overall space mission from several branches within the Army. The Signal Corps field 31-Sierra (31S) is a satellite communications specialist that can be assigned to Signal communications units as well as space support staff. Air Defense Artillery (ADA) is the branch of the Army that historically has managed missile defense and the 14-Juliet (14J) enlisted specialty manages Air Defense Tactical Operations Centers. These Soldiers typically can be found serving within JTAGS Theater Missile Warning detachments. Additionally, several subspecialties within the Military Intelligence (MI) branch have applications in the space field due to knowledge of collection platforms and familiarity with products. Based on 2006 figures, the total number of enlisted space enablers is around 625 active duty forces, 138 Reserve component, and 388 National Guard. There are plans to grow this force by approximately 75% by 2011. [103]

D. DOTMLPF ASSESSMENT

1. Doctrine

Significant effort is being expended by both the Joint world and the Army to craft doctrine for space applications. In January 2009 the Joint Publication 3-14 (JP 3-14) update was released after a seven-year gap. Many ideologies and standard operating procedures had changed since 2002 and the new publication

[102] Mike Connolly, 2009 (email correspondence with FA40 Proponent Office on March 10, 2009).

[103] David Lady, 2006. "*An Enlisted Space Cadre: A Year of Modest Progress."* SMDC. Army Space Journal 2006 Summer Edition: 8-9.

reflected much of it. Of specific note, the new JP 3-14 revises many space concepts including the streamlining of space efforts under U.S. Strategic Command and the removal of the U.S. Space Command.[104] Derived from JP3-14, Space Support to Army Operations or FM 3-14 was published in March 2005 and illustrates how the Army uses space assets to accomplish its land component mission. FM 3-14 serves as the Army's primary resource for guidance on space operations. In addition to high-level overviews on SMDC's role and essential space history, FM 3-14 discusses how Space Operations Officers interact with other Army staff elements through the space estimate and the space decision support template (SDST). The purpose of the space estimate is to recommend the most effective use of space assets to accomplish a given mission or exercise. For Division and Brigade SSEs, the space estimate demonstrates a vital means of communicating space capabilities through the G/S-3 Operations Order process to the commander. The SDST shows how space supports ongoing operations and assists in demonstrating how best to use those assets for further operations. [105] These tools are key in communicating with the command structure the value of space.

2. Organization

The organizational structure of SMDC and its many contributions to the Army are covered in great depth by LTC Scherer's work in his 2005 Master's thesis. Although some in the Army feel that Missile Defense and Space duties could be better served as two separate entities, LTC Scherer noted that they had many complementary technologies and should remain consolidated under the three-star command of SMDC. Splitting them up could potentially mean less flag level emphasis for each. [106]

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[104] JP 3-14, *Joint Doctrine for Space Operations*. Chairman of the Joint Chiefs of Staff, January 9, 2009, iii.

[105] FM 3-14, A9-A11.

[106] Scherer, 104.

As the Army's prime proponent for missile defense, space, and high altitude operations SMDC operates in a varying environment. SMDC not only coordinates missile-warning activities it serves as the Army's strategic component lead under USSTRATCOM. As the main space proponent, SMDC is responsible for an array of research, development and acquisition facilities as well as testing ranges and a battle lab. Additionally, the 1st Space Brigade supports Army operations worldwide with space support in the form of ARSSTs, CETs, SORC, and other reach back capabilities. The scope of Army Space that SMDC manages is diverse and far-reaching.

Within the Division structure, the SSE is doctrinally assigned to the G3 current operations section. Similarly, BCT SSE FA40s are assigned to the S3. In practice, the organizational location of FA40s can vary slightly more. A survey of current FA40s showed that most do work within the G/S-3 structure, but based on individual unit needs and officer strengths some work elsewhere. Anecdotal reports list FA40s employed in jobs ranging from public affairs offices and special project officers, to hurricane warning cells. More reasonably many work as battle captains in Tactical Operations Centers (TOC) or in G/S-2 sections. Generally, the lack of consistent space-related work for FA40s has led to many units finding alternate duty functions for them. The two most prevalent are the Special Technical Operations (STO) and Alternate Compensatory Control Measures (ACCM). Although neither of these is space-related, the clearance requirements prevalent in both make FA40s a logical choice to fill the need. Most likely, if no FA40 were present, someone from the G/S-2 section would accomplish the mission.

A study conducted in mid-2008 by SMDC examines what percentage of SSE personnel time is actually spent on space-related activities while deployed. Forty-two FA40s deployed over the span of six years were included in the study. The study discovered an overall percentage of 45% of SSE time is spent on space and 55% spent on other duties. Taken at face value, this seems in sync with typical Army officer duties from other functional areas. However, as

demonstrated in Table 9, a closer look at the dates the SSEs were surveyed shows a clear trend away from space utilization.[107]

	Time spent on space	Time on non-space
Years 2002-2003	95%	5%
Years 2004-2006	42%	58%
years 2006-2008	31%	69%

Table 9. FA40 Utilization Breakdown[108]

The trend away from space in the SSE is the product of several factors. At the outset of OIF/OEF there was very little imagery and units were deploying to areas for the first time. This results in an elevated requirement for space products and a clear application for FA40s. As the war continues, less of these products are needed and fewer space applications are necessary to accomplish the mission on a tactical level. In the modern Divisional structure traditional sections cover many of the space provided resources. The G2 maintains equipment and sections that specialize in IMINT, MASINT, and SIGINT. Similarly, the G6 is tasked with monitoring the satellite communications infrastructure as well as frequency management. Additionally, the Division Weather Officer monitors space weather effects. The space expertise brought by the FA40 to the Division staff is largely already within the Division staff in other sections. The apparent double-coverage of space products is a potential area where FA40 utilization could be altered for better efficiency.

3. Training and Education

The training model used within SMDC produces qualified members of the Army Space Cadre. Once accessed into the FA40 career field, officers attend

[107] Bill Coffey, 2008. *Space Employment Data*. SMDC- FWC. (spreadsheet prepared by SMDC to study FA40 utilization obtained from SMDC on January 4, 2009).

[108] Ibid.

the Space Operations Officer Qualification Course (SOOQC) in Colorado Springs, CO. The SOOQC is conducted twice a year with approximately thirty students per course and teaches basic orbital mechanics along with an introduction to national systems. In 2005, SMDC developed and began to conduct the Tactical Space Operations Course (TSOC) in order to prepare officers scheduled to work in SSEs. The TSOC focuses on skills necessary for tactical space applications and includes practical exercises on many topics. A small subset of the topics includes GPS electromagnetic interference, BFT integration, commercial satellite imagery, satellite communications systems, overhead persistent infrared systems, and environmental effects on communications.[109]

The FA40 community utilizes several different methods to educate members of the space cadre. Many FA40 personnel are selected to attend Advanced Civil Schooling to obtain graduate degrees in space systems or to work in the space industry for a period of time. There is also a selection of distance learning opportunities available through SMDC in the form of seven online courses. Augmenting formal instruction, SMDC coordinates continuing education in the form of annual conferences, symposia, and a quarterly journal. Training is a point of emphasis within the Army space community and an area of note.

4. Material

Division and Brigade space material capabilities are best demonstrated through the example of the ARSST and SSE equipment sets. The prevailing concept at the tactical level is to provide a high bandwidth communications platform with computers capable of using image-processing software. As the available bandwidth of military networks increases and availability of high data rate SIPR and JWICS in the tactical arena becomes more feasible, the reliance

[109] Bob Guerriero, Robert Zaza, and Bill Coffey, 2008. "The Tactical Space Operations Course." *Army Space Journal Winter Edition*: 52.

on separate communications systems is less intense. The main piece of equipment used by the SSE today is the laptop computer.

5. Leadership and Personnel

LTC Scherer's thesis covers an overall Army perspective of space leadership and this thesis focuses primarily on tactical leadership impacts. The two prevailing trends in FA40 tactical leadership follow in line with the ARSST and SSE structure. One is centralized and standardized based on the ARSST model and the other depends on unit specific requirements and resources.

All ARSSTs deployed and maintained throughout the Army come from the 1st Space Brigade. An O-6 Army Colonel commands the unit and chapter III-B details the structure of the brigade. The 2nd Space Company is responsible for both the active duty ARSSTs and CETs. Reserve space teams are also found within the 1st Space Brigade in the 3rd and 5th Space Companies. The Space Company manages deployments, ensures training, and maintains equipment used for their mission. The organic leadership of the Space Company and the entire Brigade provides a chain of command that supports the teams.

Space Support Elements typically consist of two FA40 officers as shown in section III. Utilization of the FA40s within the Division falls upon the G3. Within the Division G3 Current Operations section, the duties of the FA40 are determined. Based on the study of FA40 utilization, when space requirements are clearly understood and needed the application of the SSE towards space can be as high as 100%. This is evident in the study for the time period at the beginning of OIF/OEF. When the requirements become less clear or when the employment of space products/services has been routinely incorporated into current operations, as in the case of more recent years of OEF/OIF, application of SSEs away from space is seen. The key ingredient for either scenario is leadership knowledge of potential space applications. In well-defined activities, leadership can see the space contribution. In steady state operations, the space contribution is less apparent. In these less apparent examples, it is incumbent

on the FA40 to understand areas they can impact operations and to make other staff elements aware. The lack of space understanding is an organizational issue that requires continual effort by both SMDC and the FA40 SSE community in direct interaction with Division leadership to resolve. In situations where minimal space capabilities are required, and an FA40 is not needed, another staff officer with a 3Y identifier could satisfy the unit's space requirements.

In Brigade sized units, the presence of an FA40 is rarely effective. There is simply not enough of a requirement for space capabilities to warrant an O-4 FA40 to be assigned there. The FA40 typically is assigned to special projects or staff duties well outside the boundaries of space operations. The fielding of FCS BCTs with FA40 officers is not an effective use of those personnel. Staff officers or NCOs with 3Y identifiers can easily accomplish the limited space requirements in the BCTs with no loss to the unit and a more effective reallocation of the FA40.

Assessing the leadership aspect of the Division and Brigade FA40 is a two-sided argument. Originally, the SSEs were placed in the Divisions so that they would have a space asset organic to the unit for both deployment and garrison purposes. The logic behind the decision rests with the concept that ARSST support was so effective that a full-time space team would provide the same level of service for the unit all the time. From the Division point of view, having organic space assets for the occasional requirement justifies their constant presence. The other side of the argument involves the concept of maintaining the proficiency of a highly trained work force. Following a space-centric academic training program an SSE team member is assigned for two-years to a Division staff. They may not retain all of the space-related knowledge an FA40 assigned to either an ARSST or another space job would. The specifics of each SSE FA40 may be different, but the concept of taking a technically skilled individual completely out of their environment for two years with the expectation they can reassume those duties once complete is difficult to manage. A more effective use of those personnel would be to readdress the assignment process for SSEs and consider other alternatives.

E. BETTER METHODS

1. Leadership Education

Integrating space into everyday operations no longer requires the continual presence of space staff at the Division and Brigade levels. Education of both leadership and staff elements is vital in transitioning the Army to a fully integrated world of organic space support. As space becomes more practiced and routine, non-FA40 personnel can fulfill the minimal space related actions required. Understanding that extra capabilities exist with more robust space teams, such as ARSSTs, commanders can use their organic personnel knowing that all of their future requirements will be met. For example, the intelligence analyst can do their primary job and obtain space products as needed. When the need for expanded capabilities is identified, the 1st Space Brigade can fulfill those needs. By empowering leaders and staff with a grasp of what space can do at their level, they can make better decisions about when they need space assets and new ways to use SOO skills.

To augment the Division staff and unit level training, the institution of training teams could demonstrate space effects in training environments. A team of FA40 trainers located at the major training centers such as the National Training Center (NTC) or the Joint Readiness Training Center (JRTC) could inject space into exercise planning and operations. The opportunity for tactical staff elements to employ space products in realistic exercise scenarios would greatly enhance their confidence in using those products. Additionally, First Army training centers for Reserve and National Guard units could incorporate space education and exercise effects into mobilization plans. The result could have a two-fold benefit of educating combat leaders and training staff elements to better use space products.

2. Broaden the Space Cadre

The intent of pushing FA40s down to Division and BCT levels in the form of the SSE is to provide space capabilities organically. Despite the high percentage of filled authorized positions, using FA40s for less than one-third of the time is not efficient. Those personnel could be better utilized within the upper echelon Army space cadre overseeing existing programs, educating the force, working on inter-service systems, increasing ARSST capabilities, and developing the next generation of space assets. To fill the Division or BCT Commander's occasional requirement for space the unit could utilize existing staff elements, such as the G3 or G6, with 3Y identifiers and focused training to provide space products. If a major deployment requires additional space support, an ARSST could be requested. Reallocating FA40s from SSEs to ARSSTs would significantly increase the availability of resources.

Several enlisted specialties are involved in space capabilities, but no single occupational specialty mirrors the FA40. Developing an enlisted FA40 would greatly enhance the ability to spread space knowledge around the Army. An enlisted FA40 could be assigned to virtually any level of unit and bring expertise that no single intelligence or communications Soldier could provide. In comparison to the other services, only the Air Force has a permanent officer space specialty similar to the FA40, and they also maintain an enlisted space force. The Army enlisted personnel currently working the space field are considered "space enablers" and they come from MI, Signal, ADA, and Engineer enlisted branches. Some possess the 3Y identifier and work in space-related jobs, but no standardized career field exists. In his article "An Enlisted Space Cadre," CSM David Lady noted that many enlisted who worked in space related jobs had little or no formal space education and were forced to pick up skills on-the-job. There are over 1000 enlisted Soldiers across active duty, the Reserves, and the National Guard currently working in the space field.[110] Standardizing the

[110] Lady, 8.

training and developing the space career field would greatly enhance the training of those Soldiers already doing the job and provide a commonly trained resource to propagate space throughout the Army.

3. Emphasize the ARSST

The ARSST represents an ideal tactical space asset. The personnel assigned to ARSST units remain well submersed in space activities and ensure a high degree of proficiency for deploying units. Contrasted with the minimally used space skills of the SSE, the ARSST brings a suite of space equipment and the backing of the 1st Space Brigade's space resources. To provide the tactical commander the best possible space expertise, focus tactical space on 1st Space Brigade's ARSST Model. To achieve this, take SSEs out of Division and BCTs and use them to supply personnel for an additional five active duty ARSSTs. The application of 3Y staff officers and enlisted FA40s in the Divisions and BCTs ensure the unit has continual space capabilities. With these additional ARSSTs the ability to provide space assets to twice as many deploying units is possible. The more side-jobs the SSE guys get, the less space they remember.

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V. RECOMMENDATIONS

A. FINDINGS

There are wide varieties of space assets available to the tactical commander at the Division or BCT level. The Army Space Cadre provides the commander satellite communications that enable worldwide connectivity, GPS-based technologies that enable unsurpassed situational awareness, and intelligence platforms that provide strategic products at the tactical level. The impact of these resources has been dramatic on the conduct of war in the modern era.

In parallel to the development of space systems, the Army instituted a space personnel structure to provide expertise as well. The growth of the FA40 career field enabled space access to tactical units in the form of the ARSST and the SSE. ARSST teams are attached to a deploying unit and provide space products while deployed and an SSE is an organic space resource for both Division and Brigade units. Though both are staffed with FA40 personnel, the actual space-related workload varies significantly. ARSST members work within space related duties the majority of the time where SSE members work with space can vary from zero to an average of 30%. Initially designed to provide the capability of an ARSST to a Division or Brigade commander in an organic asset, the SSE does not represent an efficient use of FA40 personnel.

B. FINAL RECOMMENDATIONS

A tactical commander whether at the Division, Brigade, or Company level has requirements for information that can be potentially met in many ways. Although they may desire organically assigned space personnel, the requirement may be adequately met through the use of other sources. Due to the documented lack of space-related utilization of many of the FA40s working at Division levels or below a more efficient method of providing space capabilities is

necessary. To facilitate a balance between the space needs of the Army in general and the tactical needs of the commander there are three general recommendations for improved support.

The first recommendation is to establish a training plan within SMDC to reach out to Division leadership and staff to educate them on what space can provide. In conjunction with this training, there should be an addition to the Tactical Space Operations Course curriculum to include methods to help SSE officers communicate space effectively to their leadership. This curriculum addition would assist newly assessed FA40s in identifying areas where space can contribute and better ways to work those items into unit operations.

The second recommendation is to alter the Army Space Cadre concept. Personnel with 3Y identifiers should be used at Division and BCT commands in lieu of FA40s. These pre-existing G/S-2 and G/S-6 personnel can fulfill the occasional space requirements while allowing FA40 personnel to remain involved in more space-intensive occupations. Also, an FA40 enlisted specialty should be established. Enlisted from several different specialties currently work in the space field with no formal space training. Standardizing enlisted space training and developing a career field similar to the FA40 would not only ensure a more qualified work force, but would add an element of flexibility to spread space expertise around the Army.

The third and final recommendation is to gear the tactical space support model after the ARSST. Reallocating SSE FA40s would provide the personnel to build an additional five active duty ARSSTs. With these new teams, twice as many space support opportunities would exist. Additionally, the continual focus of ARSSTs on space-related training and equipment would ensure the most qualified space expertise available for the tactical commander. This change in structure would ensure that the total FA40 force remained well trained and the tactical user's requirements remain met.

LIST OF REFERENCES

1st Space Brigade. GlobalSecurity. http://www.globalsecurity.org/space/agency/1space-bde.html (last accessed January 23, 2009)

Association of the United States Army (AUSA). 2004. Army Space Forces – Enabling the Joint Warfighter. *Institution of Land Warfare Journa*l no. 100: 3.

Bartley, John. 2008. *Spin Out Early Infantry Brigade Combat Team Acquisition Strategy. Program Manager FCS (BCT)* (briefing presented 2008 and accessed via AKO on February 14, 2009).

Bernstein, Lewis. 2005. Army Space Support Teams: The Early Years 1986–1998. *Army Space Journal Winter Edition*: 1F.

Breitbach, Daryl. 2008. *Army Space Support Team – Tactical Set: Overview*. SMDC. (Briefing presented for DCD training August 2008 an accessed via AKO January 23, 2009.)

Butler, Karen. 2004. New Colors, New Era for 1st Space Battalion. *Army Space Journal Fall Edition*: 38.

Campbell, Kevin T. 2008. 50 Years in Space. *Army Space Journal Winter Ed*. 7(1): 4.

Coffey, Bill. 2009 (comments noted during telephone conversation on January 2, 2009).

Coffey, Bill. 2008. *SSEs Authorized by MTOE*. SMDC (spreadsheet obtained via email from SMDC Future Warfare Center).

Coffey, Bill. 2008. *Space Employment Data*. SMDC- FWC (spreadsheet prepared by SMDC to study FA40 utilization obtained from SMDC on January 4, 2009).

Cogan, Kevin J. and De Lucio, Ray. 2004. *Network Centric Warfare Case Study: U.S. V Corps and Third Infantry Division during Operation Iraqi Freedom Combat Operations (March–April 2003. Carlisle Barracks, PA: U.S. Army War College: 22.*

Connolly, Mike. 2009 (email correspondence with FA40 Proponent Office on March 10, 2009).

DataPath Integrated Solutions. http://www.thedatapathuplink.com/issue1/ET3000.gif (accessed January 17, 2009).

Department of the Air Force. Air Force Modeling and Simulation Resource Repository. 2007. *Air and Space Constructive Environment Integration.* https://afmsrr.afams.af.mil/index.cfm?RID=SMN_AF_1000106 (accessed January 23, 2009).

Department of the Army. 2008. Army Campaign Plan 2008 EXORD – Unclassified excerpt only. Office of the Deputy Chief of Staff, G-3/5/7 (accessed from Army Knowledge Online on February 14, 2009):3.

Department of the Army. Field Manual 3-14. 2005. *Space Support to Army Operations*, Space and Missile Defense Command: II-4.

Department of the Army. Field Manual 6-02.60. 2006. *Tactics, Techniques, and Procedures for the Joint Network Node – Network*. Washington D.C.: 4-3.

Department of the Army, Army Space Master Plan. SMDC (Washington, D.C.: US Government Printing Office, 2000):11.

Department of the Army. U.S. Army 25E Training Course Handbook. 2008. *The Army Satellite Communications Architecture Book.* January 2008. U.S. Army Signal Center, Fort Gordon, GA.: 6-164.

Department of the Army. U.S. Army Central Training System Facility. 2006. *Warfighter's Guide to Army Battle Command System 6.4*: 49.

Department of the Army. U.S. Signal Center. 2005. *The Integrated Theater Signal Battalion: Way Ahead* (briefing given March 2005 at Fort Gordon, GA).

Department of Defense, Joint Staff Joint Publication 3-14. *Joint Doctrine for Space Operations*, Chairman of the Joint Chiefs of Staff, August 9, 2002, II-4.

Eagle Vision demonstration photo (taken during U.S. Air Force Memorial Dedication and Pentagon Open House October 2, 2006 (accessed from http://flickr.com/photos/45479866@N00/347837649 on February 5, 2009).

FA40 Proponent Office. *What is Skill Identifier 3Y?* Human Resources Command. http://www4.army.mil/FA40/skillid.php (accessed on February 26, 2009).

Farnsworth, Jeff and Lewis, Rich. 2008. *Evolving Our Operating Concepts Optimize Current & Enable Emerging Capabilities. 1st Space Brigade* (briefing conducted at FA40 Symposium 2008 and accessed from AKO February 3, 2009).

Fort Sill Battle Command Training Center. Army Battle Command System Overview (slides prepared for BCTC training and accessed from AKO on February 5, 2009): slide 63.

Future Warfare Center. 2008. *SATURN: Space Application Technology User Reachback Node*. SMDC. http://www.smdc.army.mil/FactSheets/SATURN.pdf (accessed December 30, 2008).

Future Warfare Center. *Space Operations System: SOS*. SMDC-FWC. http://www.smdc.army.mil/FactSheets/SOS.pdf (accessed December 30, 2008).

Garmin Corporation. 2000. *GPS Guide for Beginners* (Garmin GPS user manual) Olathe, KS: 5.

Gehrke, Lenard. 2008. *Global Positioning System. Space and Missile Defense Command* (briefing posted November 2008 and accessed from Army Knowledge Online on February 2, 2009).

Grebe, Joesph. 2008. *TES Family of Systems Support" Distributed Common Ground System – Army* (Logistics Briefing June 2008 and accessed on AKO on 26 January 2009).

Guerriero, Bob. Zaza, Robert N., and Coffey, William. 2008. The Tactical Space Operations Course. *Army Space Journal Winter Edition*: 52.

Harris Radio-Communications. *AN/PRC-117/G Specifications*. http://www.rfcomm.harris.com/products/tactical-radio-communications/an-prc-117f-hq.pdf (accessed January 17, 2009).

Hughes, Alan. 2009. *FA40A Strength* (spreadsheet provided by FA40 Proponent Office).

Jane's Information Group. 2001. *BRITE lights the way for small-unit intelligence imagery*. http://www.janes.com/extract/idr2001/idr00598.html (accessed January 23, 2009).

Keller, Eric R. 2002. Digital Transformation of the Army and the Unit Ministry Team. *The Army Chaplaincy.* Summer-Fall. http://www.usachcs.army.mil/TACarchive/ACsumfal02/ Keller.htm (accessed on February 2, 2009).

Lady, David. 2006. *An Enlisted Space Cadre: A Year of Modest Progress*. SMDC. *Army Space Journal* 2006 Summer Edition: 8-9.

Larson, Wiley J., and Wertz, James R., eds. 1999. *Space and Mission Analysis and Design*. El Segundo, CA: Space Technology Library: 73.

Marth, Richard B. Sr. 1992. *GPS Army Research and Applications*. U.S. Army Topographic Engineering Center. http://handle.dtic.mil/100.2/ADA254262 (Information paper published at Fort Belvoir, VA (accessed January 22, 2009) :5

National Academy of Sciences. *The Global Positioning System: The Role of Atomic Clocks.* http://www.beyonddiscovery.org/content/view.page.asp?I=1275 (accessed January 22, 2009).

Network Centric Warfare Case Study: Blue Force Tracker. 2006. http://www.carlisle.army.mil/usacsl/Publications/NCWCS%20Volume%201/13%20NCWCS%20Volume%201%20(Appendix%20D).pdf. Carlisle Barracks, PA (accessed January 22, 2009).

Olsen, Richard C. 2007. *Remote Sensing from Air and Space*. Bellingham, WA: SPIE Press: 57.

Overwatch Textron Systems. *ELT/3500 Product Overview*. Overwatch Company website. http://www.elt.overwatch.com/3500_overview.php (accessed January 23, 2009).

Pedone, LeRoy. 1999. *Integrated Space Command and Control*. USSPACECOM. http://sunset.usc.edu/gsaw/gsaw99/pdf-presentations/session-2/pedone.pdf (accessed January 23, 2009).

PEO IEW&S. *Tactical Exploitation System*. Army Space Program Office. (accessed via AKO January 15, 2009).

Pietrafesa, Rob and Scott Matey. 2004. Space experts provide warfighter access to commercial imagery. SMDC. *The Eagle* Volume 11, No. 7: 21.

Pitt, Rodger S. 2008. Realities of the Space Age & the Realities of Carl von Clausewitz's Theories of "Fog and Friction," *Army Space Journal* 7(2): 55.

Program Manager FCS Brigade Combat Team. 2007. *FCS 101 Employee Orientation* (briefing given to civilian PM employees on March 5, 2007, and accessed via AKO on February 14, 2009).

Rayburn, John C. and James E. Carson. 2008. *Design, Build, and Test a Hand-Held GPS Interference Detector.* Master's Thesis, Naval Postgraduate School: 11.

Raines, Rebecca Robbins. 1996. *Getting the Message Through: A Branch History of the U.S. Army Signal Corps*. Washington D.C.; Center of Military History: 349.

Rozzi, Jim & Bill Coffey. 2008. *SSE Mission*. SMDC (obtained via email from Bill Coffey, SMDC Future Warfare Center on January 2, 2009).

Scherer, Clay. 2005. *Army Space and Transformation*. Naval Postgraduate School Masters Thesis: 36.

Slayter, Terry. *New Material Introductory Briefing – IMETS. PEO C3T – Product Director Intelligence Fusion* (accessed from AKO on February 5, 2009).

Souder, Jeffrey. 2003. Space Support Element Toolset, etc: Rapid Prototyping Support to Army Space Forces. *Army Space Journal – Special Edition 2003*. SMDC: 22.

Space and Missile Defense Command. ARSST Companies in the 1st Space Battalion (briefing given during 2004 AUSA seminar an accessed from AKO on February 3, 2009).

Space and Missile Defense Command. 2007. *FA40 Professional Reference Guide* (space Operations Officer Qualification Course handout. Peterson AFB, CO): 52.

Space and Missile Defense Command. 2008. FA40 Roster version 2.51 (spreadsheet obtained from Bill Coffey via email dated December 4, 2008).

Space and Missile Defense Command. Tactical Space Operators Course. 2005. *Space Support Enhancement Toolset* (course presented December 2005, and accessed from Army Knowledge Online on January 23, 2009).

Space and Missile Defense Command, 2009. What is SMDC/ARSTRAT? Army Organizational Website. http://www.army.mil/institution/organization/unitsandcommands/commandstructure/smdc/ (accessed January 4, 2009).

Space and Missile Defense Command. *US Army Space Support Element (SSE) History 1998-2006: From Concept to Combat Capability* (brief, Peterson AFB, CO, October 2006).

Valine, Debra. 2004. Battle Lab systems evolving to meet warfighters' needs. *Army Space Journal* Fall 2004. SMDC: 36.

Van Crevald, Martin. 1985. *Command in War*. Cambridge, MA: Harvard University Press: 44.

Warren, Ken. 2007. WGA Launch ushers in new era of information dominance. *45th Space Wing Public Affairs,* October 10..http://www.patrick.af.mil/news/story.asp?id=123072439 (accessed January 17, 2009).

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